THE
HANDMAID
John TO THE Edward
ARTS,
VOL. THE SECOND.

TEACHING,

I. The preparation of *inks*, *cements*, and *sealing-wax*, of every kind.

II. The art of *engraving*, *etching*, and *scraping mezzotintos*; with the preparation of the *aqua fortis*, varnishes, or other grounds, &c. in the best manner now practised by the French; as also the best manner of *printing copper-plates*; an improved method of producing *washed prints*, and of *printing in chiaro obscuro*, and *with colours*, in the way practised by Mr. *Le Blon*.

III. The nature, composition, and preparation of *glass* of every sort; as also the various methods of counterfeiting *gems* of all kinds, by *coloured glass*, *pastes*, *doublets*, or the use of *foils*.

IV. The nature and composition of *porcelain*, as well according to the methods practised in China, as in the several European manufactories; with the best manner of burning, glazing, painting, and gilding the ware.

V. Preparation of *transparent* and *coloured glazings*, for stone or earthen-ware.

VI. The manner of preparing and moulding *papier mache*, and whole paper, for the forming boxes, frames, festoons, &c. and of varnishing, painting, and gilding the pieces of each kind; with the method of making the light Japan-ware.

To which is added an APPENDIX;

CONTAINING

Several supplemental articles belonging, in some manner, to heads before treated of, either in this or the first volume; particularly, the method of *marbling paper*, of *taking off paintings from old and transferring them to new cloths*; of *weaving tapestry*, both by the *high* and *low warp*; and of manufacturing *paper hangings* of every kind.

The SECOND EDITION, with considerable Additions and Improvements.

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THE

PREFACE.

THIS volume of the Handmaid to the Arts *contains ſuch additional articles, as, either for want of room, could not be inſerted in the firſt, or, not being ſtrictly a part of the deſign, were omitted there; though, from their affinity with it, and their common utility, they may juſtly claim to be joined to it in a ſupplemental light.*

The general title of the work points out the object of its contents, viz. an attempt to teach the knowledge of all ſuch matters as are ſubſervient to the arts of deſign, but yet not abſolutely a part of thoſe arts themſelves; *and the preface to the firſt volume ſhews more explicitly the nature of the undertaking, and the motives of the author for entering upon it. It is therefore needleſs to enlarge further on theſe points here in a general view, as nothing more is wanting than to give ſome account of the manner in which the ſeveral particulars, which form this volume, are here treated of.*

The preparation of inks, ſealing-wax, *and* cements *of every kind, makes the firſt part. The reaſons for their being made a part of this*

work were as well their great general usefulness for many other purposes of life, as their being necessary in the practice of several of the principal arts of design, though not immediately belonging to any in particular. Black writing ink, more especially, is of the utmost importance, and the composition of it of a very nice and precarious nature, as the many instances of writings wholly obliterated, or become so faint as to be scarcely legible, too frequently evince. Yet those who would avoid the hazard of being supplied with bad ink from others, by preparing themselves what they use, would find it difficult to procure, from any book, a recipe for this purpose, on which they could safely depend. Caneparius, *an Italian, has indeed written a whole volume in Latin on inks, and there are some recipes in it which are not very faulty. But he has not given any just light into the true nature and use of the several ingredients, nor, by any other means, removed the great difficulty of judging of the due relative proportion of them, on which nevertheless the success of the process chiefly depends. On the contrary, he has accumulated a multiplicity of forms, in which the widest difference in this point, that can be imagined, is found; and from the neglect of intimating in what particulars any of them are erroneous, and in what proper, though it is apparent, from the nature and degree of the difference, that if some be right, others must be wrong, he has rendered the whole of very little consequence. The succeeding writers have copied from his work, without remedying this defect, and have either*

either given, like him, a variety of recipes, ſome very bad, and others leſs faulty, without diſtinguiſhing them, or for the moſt part choſen the worſt, in which not only the ſame errors in the proportions are found, but wine, vinegar, and other ſuch unneceſſary and injurious ſubſtances, are introduced, as enhance the expence, and deprave the produce. With reſpect to the printing ink, there is little to be communicated as to the common kind; becauſe the goodneſs of that ariſes more from the choice of the ingredients, than from any ſkill in the management of them, and I have therefore treated it with proportionable brevity. But with relation to the ſort uſed for printing copper-plates, it is much otherwiſe; and, as the effect of the engraving greatly depends on the ink, the recipes here given muſt be allowed to be an improvement, with reſpect to ourſelves, of the art of printing, as they teach the manner of preparing the beſt kind now uſed in France, which is greatly ſuperior to any commonly made here; and another ſort alſo, which though not brought into practice hitherto, would greatly excel any other at preſent known.

Engraving, *with a view to the production of prints, is the ſubject of the next part, and was very eſſential to the deſign of this work; and it is hoped, that what is here offered on this head will not be leſs uſeful to the public than acceptable to thoſe who cultivate the art, as it may not only enable many, who might attempt engraving, if they were not debarred from pro-*

ceeding by the want of ſuch aid, to initiate themſelves into the rudiments, but even aſſiſt thoſe who are already advanced to ſome degree of ability in the practice of it. It was intimated in the preface to the firſt volume, that means had occurred of obtaining a conſiderable ſtock of very valuable matter reſpecting this ſubject. What was meant by that intimation was, the publication of Le Boſſe's treatiſe on the manner of etching and engraving, with the additions of Mr. Cochin. He has ſubjoined to the contents of that treatiſe, all the newer methods of the preſent practice; together with many edifying obſervations, deduced from the principles of deſign, and illuſtrated by examples of the moſt eminent maſters. So that his work is not only valuable, as conveying the greateſt part of the general rules of the art, but as imparting alſo the peculiar inventions and improvements of the French, which could be hitherto known only to thoſe who had the opportunity of ſtudying it in France. I think it proper to acknowledge, therefore, that a great part of the matter given on this head is borrowed from them; but it is preſumed this will rather be conſidered as a recommendation than a diſparagement of the work, by thoſe of our own country, where this art is of a much younger growth. The inſtructions which were required to be furniſhed with relation to engraving, in a general view, could only be laid down originally by ſuch as were thoroughly verſed as well in the practice as principles of it; and the peculiar methods of the French, only by

ſuch

ſuch as had been educated, or had reſided long there. None could be more capable or communicative of either than Le Boſſe (who was one of the firſt introducers of etching into France) has been with regard to the hard varniſh; and the ingenious Mr. Cochin, who is at preſent an eminent engraver at Paris, with reſpect to etching with the ſoft varniſh; the engraving with the tool or graver; the advantageous combination of etching, and the work of the graver, in the execution of the ſame deſign; or the general hiſtory and principles of the art. It muſt not be underſtood, neverthe leſs, that only a tranſlation is given of what Le Boſſe and Cochin have written on this ſubject. A regular treatiſe on engraving is here attempted, in which every thing neceſſary to be known, as far as relates to the execution of any deſign, is methodically taught; while thoſe two authors, on the contrary, who were much more able artiſts than writers, only touched on particular heads, and ſometimes with ſuch a deviation from the juſt order of didactic method as to render their inſtructions perplexed and difficult to be conceived. Several obſervations on, and improvements of, what Mr. Cochin has taught, as well as other particulars, are alſo added; ſo that it is preſumed what is here afforded may be much more uſeful than any tranſlation of his or Le Boſſe's works, and may contribute to advance that progreſs we are making toward a rivalſhip of the French in this art, which they have for a conſiderable time cultivated and encouraged in

the greatest degree. To the instructions for engraving are added the method of printing copper plates, and an improved manner of producing washed prints, proposed by Mr. Cochin in the above-mentioned work; with observations tending to the rendering it yet more useful. The manner of printing in chiaro obscuro, *and with colours, after the manner of Mr Le Blon, are also subjoined; and will be doubtless very agreeable articles to those who are curious in matters of this nature.*

The third part contains a dissertation on the nature, composition, and preparation of every sort of glass, *as well coloured as transparent, and consequently of the kinds manufactured for the imitation of precious stones, as well as the more coarse sorts made for common purposes. To this is annexed an account of the formation and management of* doublets; *of the means which have been employed for colouring chrystals; and also of the preparation and application of* foils *of all kinds. The manufacture of glass is an object of the greatest importance to commerce. It is more particularly so at present, as the French have gained the accidental advantages over us, in one of the most material articles, to such a degree that a very considerable sum is annually paid on account of the clandestine importation of the produce of their manufacture to us. And this notwithstanding, were matters put on a fair and equal footing, we could under-work them ten or fifteen per cent. from the natural advantages we have over them*

them in more than one circumstance. The assistances, however, given by books already published, to those who would cultivate the art of making glass, is extremely slender; though there are many writers who have pretended to teach it, and three in particular who bear a considerable reputation. The first of these is Neri, an Italian priest, who wrote an original treatise on glass, and on the preparation of pastes, or compositions for the imitation of precious stones, with some other curious arts. His book contained an account of the composition and treatment of some of the kinds of white transparent glass, then made in Italy, as likewise of the methods at that time practised with respect to colouring glass, and the preparing enamels. But he was far from having collected a full account of the Italian manufactures of glass; and where he attempted to treat the subject in a scientific manner, he betrayed great error in reasoning, and ignorance of principles: and indeed the whole of what he delivered was very imperfect with respect to method, even to the accumulating repetitions on each other. He is nevertheless still more blameable for having introduced many falsities respecting the result of processes and experiments that, he says, he had performed; and which he relates to be greatly different from what they really ever were in fact. Doctor Merret, an English physician, translated Neri, and wrote notes upon him. But not having any experimental acquaintance with the subject, nor any knowledge of the principles, except

cept what he had borrowed from a few very bad writers, he adopted all the errors of Neri; and making them and other falſe ſuppoſitions, with reſpect to facts, the data on which he formed his hypothetical reaſonings, he treated his ſubject as abſurdly as any of thoſe have ever done others, who, like him, pretend to obtain a knowledge of this kind in their cloſets. It was far otherwiſe with Kunckel, who retranſlated into his own language Neri's work, with Merret's notes; and ſuperadded many remarks and obſervations of his own on what both of them had advanced. He had been ſuperintendant of the manufactures of glaſs, and chymiſt to ſeveral of the Electors, and other German princes, who were at that time great cultivators of thoſe kind of arts, and had a very minute acquaintance with the ſubject, gained as well by a great number of ſpeculative experiments, as a conſtant attendance on the eſtabliſhed practice; to which he joined a conſiderable ſhare of natural ſagacity. His advantages, therefore, beſides that of living at a time which, though not long after Merret, had given room for many conſiderable improvements to be made, were much greater than thoſe of Merret and Neri, for writing on this ſubject; and indeed his works may be juſtly deemed proportionably ſuperior. For tho' he was illiterate in other points, and had not all the aid from natural philoſophy, and the deeper principles of chymiſtry, he might have even then received; and moreover publiſhed his obſervations on this art, only under the form of notes on thoſe two preceding writers; yet his work has a real value;

value; and as far as he has extended it, may vie with most others written on practical subjects of so curious and complex a nature. His observations with respect to white transparent glass are confined to the best kinds of glass of salts; for he neglected to give any instructions relating to those employed for coarser purposes; and the sort we now call flint-glass is of later introduction into practice. The English writers of dictionaries, and other books of arts and trades, have done nothing more than to translate or transcribe from Neri and Merret, and not understanding the changes of the practice since that time, nor what substances are employed here correspondently to those then used in Italy, they have given only what must appear to the practitioners of this art an unintelligible jargon; their receipts directing constantly the use of pulverine, rochetta, tarso, sado, greppola, &c. things which were never known here, and are scarcely at present found or even understood in Italy. With respect to the general nature of glass, in a speculative view, it has indeed been well conceived, and occasionally treated of, by several both of the German and French writers, as Henckel, Raumur, Cramer, &c. But with respect to the practical knowledge or art of making the several kinds now in use, it may be justly deemed to be hitherto untaught; as whoever should try to inform themselves of the particular qualities and composition of flint-glass, window-glass, that employed for plates for mirrors, or any other particular kind, would find the means

wholly

wholly unprovided in any books. I have therefore concisely laid down the general principles on which the nature of glass is to be explained; and then enumerated the qualities and uses of the several ingredients in the kinds now made; after which I have proceeded to give the composition, and rules for the treatment of each particular sort, so that every thing may be furnished, either for the learning the present practice, or making experiments for the further extension and improvement of the art. The preparing coloured glass for the imitation of precious stones had indeed been more extensively taught by Neri and Kunckel, and the writers after them. But in all their works, along with some good recipes, there were others intermixed that were very liable to mislead such as might make use of them, and occasion a fruitless expence of time and money. A complete set of processes for the best composition and treatment of every sort was consequently still wanting, and is here attempted to be supplied in the most effectual manner. The preparation and management of foils is a proper appendage to the coloured glass, being subservient to the same purpose, and was therefore annexed to this part of the work.

In the fourth part, the nature and manufacture of porcelain, or China-ware, *is taught, which will be doubtless acceptable at this time, when attempts are making to establish five or six different manufactories in our own country; which, considering the great advantage received from those of Dresden and Vincennes, ought certainly to meet with all the encouragement and assist-*

assistance that can be given either by the public or private persons. To this is added Mr. Raumur's method of converting glass into porcelain, *an article which, if it may not be sometimes rendered useful, is at least very curious.*

The fifth part contains a complete set of recipes for transparent and coloured glazings *for stone and earthen-ware. This article was indeed supplied before in some degree, in the first volume, by the enamel colours. But as Kunckel had made a collection of all the methods of preparing the glazings at Delft, and published it in his work; and as there are some kinds that differ from any of the compositions used for enamelling, I thought the giving the detail of the whole might be serviceable. This is indeed of greater importance at present, as there is now a great spirit of improvement in the manufacture of stone and earthen-ware, which ought to be encouraged and aided by every means, as the French have of late greatly supplanted us in this branch of commerce, even so as to supply Ireland to the amount of twelve or fourteen thousand pounds worth per annum.*

The sixth part consists of an account of the best methods of preparing the papier mache, *either applied to embossed work and bass-relieves, or to the forming boxes, &c. and to this is subjoined the method of making the same kind of small pieces, or tea-cups, saucers, &c. from whole paper, and also from saw-dust. The manufacture of the papier mache being new in this country, it is more particularly useful to propagate the art of pre-*

preparing, forming, and ornamenting it for the various purpoſes to which it is applied, that a greater number may be induced to engage in cultivating a branch of commerce in which we have already rivalled our competitors at foreign markets.

To theſe ſix regular parts of the work are added an Appendix, *containing ſuch articles as were before omitted, though belonging, in ſome manner, to the former heads. The principal are, the art of weaving tapeſtry as well by the high as low warp; the whole manufacture of paper hangings, and ſome other detached articles.*

The above ſix parts and appendix, together with the firſt volume, contain the whole of what appears to me neceſſary for the completion of the deſign of teaching all thoſe leſſer and ſubordinate arts, that are requiſite to the execution of the ſeveral arts of deſign; and I flatter myſelf, therefore, the work will be found to comprehend all the material articles that fall properly within the pretenſions of the title.

I hope alſo, they will be found to be ſo treated of, as may render them moſt extenſively uſeful, as well to profeſt artiſts as others; eſpecially, as in this edition every thing has been added, which the moſt induſtrious reſearch could procure, ſince the publication of the firſt; and the former contents corrected and explained, with the greateſt care and attention, wherever there appeared the leaſt occaſion for it.

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PART

PART I.

Of inks, cements, and ſealing-wax.

CHAP. I.

Of inks.

SECT. I. *Of inks in general.*

INKS are fluid compounds, intended to form characters, ſhades, lines, ſcrolls, or ſome other kinds of figures, on proper grounds of paper, parchment, vellum, or ſuch other ſubſtance as may be fit to receive them. They are of two kinds, *writing ink*, and *printing ink*; which, beſides their manner of uſe, differ in this, that the firſt is always formed in ſome aqueous fluid, the latter in oil.

Water being the vehicle in writing ink, it is neceſſary, beſides the tinging ſubſtances that are uſed to give the proper colour to it, to add ſome mucilagenous or viſcid body, to prevent its running or ſpreading on the paper or parchment further than the lines neceſſary

for forming the figure of the letters, characters, or lines of the writing or drawing. This intention has been found to be best answered by the addition of gum Arabic, which indeed appears to have been applied to this purpose ever since the first introduction into use of ink formed of water. But to avoid using so much of the gum as may render the ink too thick, allum is added by some in the same intention, as it weakens the mutual attraction of the paper or parchment, and the water of the ink, and therefore prevents its flowing so freely from the pen.

Writing inks have been invented of various colours, but none are in general used except black and red, though there are many yellow tinges extremely well suited to the composition of ink. But the lightness of yellow making its effect on a white ground so little prevalent, is a good reason, nevertheless, for preferring red to it, where any colour besides black is wanted.

For printing inks likewise, the oil requires a previous preparation, as well to render it more unctuous, as to make it dry the quicker. But this preparation being the reducing the oil to the state where it is called drying oils in painting, which has before been fully shewn and explained in treating of oil as a vehicle for painting, it will be needless to repeat any particulars relating to it again in the case of inks.

SECT.

SECTION II.

Of black writing ink.

THE tinging matter of black inks is most generally borrowed from two ſubſtances, galls and logwood. For though Roman vitriol, coal of various ſubſtances, and other tinging or coloured bodies, have been ſometimes uſed, yet they are either ſo much leſs efficacious, or ſo attended with diſcordant qualities, as renders the galls, eſpecially when conjoined with the logwood, greatly preferable to them. Galls are therefore by much the moſt common tinging ſubſtance employed for forming ink, though the colouring matter they contain is not in its natural ſtate black; but being extracted by water in the form of a tincture of a fuſion, requires to be conjoined with precipitated iron, in order to render it ſo. For this reaſon green vitriol or copperas is always added to the infuſion or tincture of the galls, and being conſtituted of iron, combined with the vitriolic acid, and analyzed by the gummous matter that makes the tinging part of the galls, affords iron in that ſtate proper for ſtriking the black colour.

The nicety in the compoſition of inks lies in adequating the proportion of the vitriol to the galls; for, in caſe of great error in this particular, the ink turns brown with time,

and ſometimes wholly diſappears, as there may be found too many inſtances amongſt the modern, as well as older writings. The adjuſting the reſpective quantities of theſe two ingredients, cannot, nevertheleſs, be reduced to any certain rules that will always avail in every inſtance, becauſe the difference in the ſtrength of different parcels of the galls, and in the incidental circumſtances of extracting the tinging matter from them, makes a great variation in the eſſential proportion with regard to the vitriol. This incertitude with reſpect to the durableneſs of the colour of the ink, as far as it depends on the galls, has introduced the uſe of logwood, as an auxiliary tinge; for this wood affords a gum ſoluble in water, that when ſtruck with the precipitated iron, as well as any other alkaline body, becomes a deep purple or blue tinge; which, though not of itſelf ſtrong enough to form a perfect ink, is yet of a ſufficient force, combined with the brown of the iron, to ſupport a legible colour in the ink, even if the galls fail and wholly loſe their tinging power, as frequently happens; and, indeed, when no ſuch miſcarriage occurs, the purpliſh blue tinge of the logwood, conjoined with the black of the galls, gives a beauty and ſtrength to the colour of the ink.

Privet berries have been likewiſe uſed in the ſame intention as the logwood, as they afford by preſſure, when ripe, a juice of a very ſtrong purple colour.

In

In order to make the ink work more freely, and have a greater body and more gloſſy appearance, ſugar, and ſugar-candy, are frequently added in a ſmall proportion. But there is another ſubſtance that produces this effect in a more perfect manner and greater degree, which is the pomegranate peel, which, added to the other ingredients, gives a ſhining appearance, and improves highly the effect of the ink.

Allum, as I before obſerved, is ſometimes added to the ink, but it is not neceſſary where the pomegranate peel is uſed.

There are many recipes for forming ink of wine or vinegar, inſtead of water, though the practice is certainly very erroneous; for the wine, though it does not equally obſtruct the effect of the galls as the vinegar, does yet in no degree contribute to the improvement of the qualities required in black ink; the vinegar, however, is not only unneceſſary, but really detrimental to the effect of the galls, as it neutralizes the iron, and conſequently deſtroys the tinging property of the galls which depends upon it, and therefore occaſions a very large quantity to be requiſite for the producing even any black at all in the ink. This quality of the vinegar may be eaſily demonſtrated by the mixing a ſmall proportion of it with any ink tinged only with galls, for it will inſtantly deſtroy the blackneſs, and render the ink either brown, or colourleſs like water.

Spirit of wine and brandy are ſometimes alſo added to ink, to prevent its growing mouldy; but care muſt be taken that the ſpirit be not commixt with much of the acid uſed by the diſtillers in the rectification of it, for otherwiſe it will weaken the ink, and ſometimes, as I have ſeen inſtances, even wholly deſtroy the colour.

Compoſition of common black ink.

"Take one gallon of ſoft water, and pour "it boiling hot on one pound of powdered "galls put into a proper veſſel. Stop the "mouth of the veſſel, and ſet it in the ſun "in ſummer, or in winter where it may be "warmed by any fire, and let it ſtand two "or three days. Add then half a pound of "green vitriol powdered, and, having ſtirred "the mixture well together with a wooden "ſpatula, let it ſtand again for two or three "days, repeating the ſtirring, when add "further to it five ounces of gum Arabic diſ-"ſolved in a quart of boiling water; and, "laſtly, two ounces of allum, after which "the ink ſhould be ſtrained through a coarſe "linen cloth for uſe."

The galls ſhould be good, or the ink will fail, as it very frequently does from an error in this point. The marks of their goodneſs is the appearing of a bluiſh colour and feeling heavy. Where they are light in weight, and of a whitiſh brown colour, without any blue, they

they ſhould be rejected, or a greater proportion ſhould be uſed.

In all the recipes I have ever ſeen for ink, the gum Arabic is ordered to be put undiſſolved into the mixture of water, galls, and vitriol; but however common, it is certainly a very injudicious practice; for as gum Arabic is with ſome difficulty diſſolved in ſimple water, and much more ſo in ſuch as is acidulated by ſalts like the vitriol, and clogged likewiſe with the ſolid part of the galls and the precipitated iron, it is certainly much better to make a ſolution of it in part of the water of which the ink is to be formed, previouſly to its being commixt with the other ingredients, which would otherwiſe, in ſpite of the moſt frequently repeated ſtirrings, keep it at the bottom of the veſſel, and prevent its being ever wholly freed from them and diſſolved.

Boiling either the infuſion of the galls, or the mixture after the addition of the vitriol, has likewiſe been frequently ordered and practiſed. It is nevertheleſs not only needleſs, but injurious to the preparation of the ink, as it can have no effect on the vitriol, beſides conducing to the ſolution of it, which is eaſily effected in the proportion of water proper to be uſed without any heat; and with reſpect to the galls, their tinging power reſiding in an eſſential oil that is volatile and will riſe with leſs heat than that of boiling water, it is neceſſarily leſſened by the evaporation; and conſequently, though more of it may be ex-

 tracted

tracted from the galls, yet leſs will be retained in the fluid than if infuſion with a gentle heat be uſed inſtead of decoction.

Having thus given the beſt means of preparing black ink in the common and ſimpleſt manner, I will ſubjoin a recipe for forming the moſt perfect ink, which will be, nevertheleſs, found very little more expenſive and troubleſome than the common kind, though greatly ſuperior both with reſpect to the beauty of the colour, and the ſecurity of its ſtanding well.

Improved compoſition of black writing ink.

"Take a gallon of ſoft water, and boil in "it a pound of chips of logwood for about "half an hour. Take the decoction then off "the fire, and pour it from the chips while "boiling hot on a pound of the beſt Aleppo "galls beaten to powder, and two ounces of "pomegranate peels put into a proper veſſel. "After having ſtirred them well together "with a wooden ſpatula for ſome time, place "them in the ſun-ſhine in ſummer, or "within the warmth of any fire if in winter, for three or four days, ſtirring the "mixture again as often as may be convenient. At the end of that time add half "a pound of green vitriol powdered, and "let the mixture remain four or five days "more, ſtirring it as frequently as may be "convenient, and then add further four

"ounces

"ounces of gum Arabic diſſolved in a quart
"of boiling water, and after giving the ink
"ſome time to ſettle, ſtrain it off from the
"dregs, through a coarſe linen cloth, and
"keep it well ſtopt for uſe."

If the ink be deſired to ſhine more, the proportion of the pomegranate peel muſt be increaſed; and in the country, where the logwood cannot be ſo eaſily procured, a pound of ripe privet berries may be ſubſtituted for it.

In order to ſecure this ink from growing mouldy, a quarter of a pint or more of ſpirit of wine may be added; but to prevent its containing any acid, which may injure the ink, a little ſalt of tartar or pearl-aſhes ſhould be added previouſly, and the ſpirit poured off from it, which will render it innocent with regard to the colour of the ink.

Theſe are the beſt recipes for the kinds of ink now in uſe; but for the ſake of thoſe who are fond of variety, I will add one recipe for an ink prepared on other principles, formerly ſometimes uſed, and at firſt invented probably on account of that failure of the colour of the ink made of galls, which might be experienced, particularly when injudiciouſly prepared.

Compoſition for black writing ink without galls or green vitriol.

"Infuſe a pound of pomegranate peels,
"broken to a groſs powder, for twent-four
"hours

"hours in a gallon and a half of water, and "afterwards boil the mixture till one-third of "the fluid be wasted. Add then to it one "pound of Roman vitriol, and four ounces "of gum Arabic powdered, and continue "the boiling till the vitriol and gum be "dissolved, after which the ink must be "strained through a coarse linen cloth, and "will be fit for use."

This ink is somewhat more expensive, and yet not near so good in hue as that made by the preceding method; but the colour which it has is not liable to vanish or fade in any length of time, and therefore very curious persons may have some satisfaction in being possessed of such a recipe.

Preparation of a powder for forming good black ink extemporaneously by the addition of water.

"Infuse a pound of galls powdered, and "three ounces of pomegranate peels, in a "gallon of soft water for a week, in a gentle "heat, and then strain off the fluid through "a coarse linen cloth. Add then to it "eight ounces of vitriol dissolved in a quart "of water, and let them remain for a day or "two, preparing in the mean-time a decoc-"tion of logwood, by boiling a pound of the "chips in a gallon of water, till one-third be "wasted, and then straining the remaining "fluid while it is hot. Mix the decoction "and the solution of galls and vitriol toge-

"ther, and add five ounces of gum Arabic, "and then evaporate the mixture over a com-"mon fire to about two quarts, when the "remainder must be put into a vessel proper "for that purpose, and reduced to dryness in "*balneo mariæ;* that is, by hanging the "vessel in boiling water. The mass left, "after the fluid is wholly exhaled, must be "well powdered; and, when wanted for "use, may be converted into ink by the "addition of water."

It was formerly the practice in compounding the portable inks, to mix the galls in substance with the other ingredients, and form the composition only of them with vitriol and gum Arabic powdered together. But besides the clogging and fouling it with the ligneous matter of the galls, there could be no dependance on the standing of ink so imperfectly formed.

Compositions were also formerly made for portable, or extemporaneous inks, without galls or vitriol, of one of which the following is a recipe.

"Take half a pound of honey, and the "yolk of an egg, and mix them well toge-"ther. Add two drams of gum Arabic finely "levigated, and thicken the whole with "lamp black to the consistence of a stiff "paste, which, being put to a proper quantity "of water, may be used as ink."

SECT.

SECTION III.

Preparation of red writing ink.

" TAKE of the raſpings of Braſil wood
" a quarter of a pound, and infuſe
" them two or three days in vinegar, which
" ſhould be colourleſs where it can be ſo pro-
" cured. Boil the infuſion then an hour over
" a gentle fire, and afterwards filter it, while
" hot, through paper laid in an earthen cul-
" lender. Put it again over the fire, and diſ-
" ſolve in it, firſt half an ounce of gum
" Arabic, and afterwards of allum and white
" ſugar, each half an ounce."

Care ſhould be taken that the Braſil wood be not adulterated with the Braſiletto or Campeachy (commonly called peachy) wood, which is moſtly the caſe when it is ground; and though a very detrimental fraud, in all inſtances of the application of Braſil wood to the forming bright red colours, cannot yet be perceived after the mixture of the raſpings, but by trial in uſing them; it is therefore much the beſt way, when wanted for purpoſes like this, to procure the true Braſil wood in pieces, and to ſcrape it with a knife, or raſp it with a very bright file (but all ruſt of iron muſt be carefully avoided), by which means all poſſibility of ſophiſtication is of courſe prevented.

Red

Red ink may likewiſe be prepared, by the above proceſs, of white wine inſtead of vinegar; but it ſhould be ſour, or diſpoſed to be ſo, otherwiſe, a third or fourth of vinegar ſhould be added, in order to its taking the ſtronger tincture from the wood. Small beer has been ſometimes uſed for the ſame purpoſe, but the ink will not be ſo bright, and when it is uſed, vinegar ſhould be added, the quantity of gum Arabic diminiſhed, and the ſugar wholly omitted.

Preparation of red ink from vermilion.

"Take the glair of four eggs, a tea-ſpoon-
"ful of white ſugar or ſugar-candy beaten to
"powder, and as much ſpirit of wine, and
"beat them together till they be of the con-
"ſiſtence of oil; then add ſuch a proportion
"of vermilion as will produce a red colour
"ſufficiently ſtrong, and keep the mixture
"in a ſmall phial or well-ſtopt ink bottle for
"uſe. The compoſition ſhould be well
"ſhaken together before it be uſed."

Inſtead of the glair of eggs, gum water is frequently uſed; but thin ſize, made of iſinglaſs with a little honey, is much better for the purpoſe.

SECT.

SECTION IV.

Preparation of green writing ink.

" TAKE an ounce of verdigriſe, and
" having powdered it, put to it a quart
" of vinegar, and, after it has ſtood two or
" three days, ſtrain off the fluid; or, inſtead
" of this, uſe the chryſtals of verdigriſe diſ-
" ſolved in water; then diſſolve, in a pint
" of either of theſe ſolutions, five drams of
" gum Arabic, and two drams of white
" ſugar."

SECTION V.

Preparation of yellow writing ink.

" BOIL two ounces of the French berries
" in a quart of water, with half an
" ounce of allum, till one-third of the fluid
" be evaporated, and then diſſolve in it two
" drams of gum Arabic, and one dram of
" ſugar, and afterwards a dram cf allum
" powdered."

SECTION VI.

Of printing inks.

PRINTING inks, as I before intimated in the general account of inks, are compounded of drying oil, and ſome pigment of the colour required in the ink. The goodneſs of the ink depends, therefore, both on the compoſition of the drying oil and the perfection of the colouring pigment. At preſent, however, printing ink is ſeldom uſed of any other colour than black or red; and, except in the caſe of engravings on copper-plates, the common drying oil, mixt with crude linſeed oil and lamp black, is made to anſwer the purpoſe. The beſt proportion of the lamp black to the oil is ſaid to be about an ounce to a pound, and the reſt muſt depend on the goodneſs of the materials uſed.

For the more perfect black printing ink, proper for copper-plates and ſuch other nice purpoſes, a drying oil prepared from nut oil, and the German black made at Frankfort, and ſome other places, from the lees of wine, ſhould be uſed. The moſt approved method of preparing this oil, and mixing it with the black, is as follows.

Pre-

Preparation of black printing ink for engravings on copper, or other nice purposes.

"Take any quantity of the beſt nut oil, "and put it into an iron pot with a cover well "fitted to it, of which pot it muſt fill only "two-thirds. Place it on a fire, and, having "put on the cover, let it continue in that ſtate "till it makes an ebullition, when it muſt be "very well ſtirred to prevent its boiling over. "Suffer it then to catch fire, or kindle it by "a lighted paper, and when it flames take "it from the fire, and place it in a corner of "the chimney, where let it continue to burn "half an hour, frequently ſtirring it. Ex-"tinguiſh then the flame, by putting the "cover on the pot; or, if that be not effec-"tual, by putting a wet cloth over it. This "produces the weak oil which has the prin-"cipal part in the compoſition of the ink. "But a ſtrong oil muſt likewiſe be prepared by "the ſame means, only inſtead of extinguiſh-"ing the flame at the end of half an hour, it "it muſt be continued till the oil be rendered "very thick and glutinous, which muſt be "examined by taking a little cut of the pot, "and ſuffering it to cool; when, if it be "found to be extremely adheſive and ropy, ſo "as to be drawn out in long threads, it is "ſufficiently burnt, and the flame muſt be "put out. This is the ſtrong oil, of which "a proportion is to be uſed along with the

"other

" other in the printing ink. Having prepared " these oils, take half a pound of the Frank- " fort, or any other good black, and grind " it with the addition of only so much of the " weak oil as is necessary to make it work on " the stone, which will be generally some- " thing less than half the weight. The whole " being first incorporated together, and after- " wards thoroughly well mixt by a second " grinding, (having only a small quantity on " the stone at a time) a quantity of the strong " oil must be added, which may be as much " as is equal to the size of a small hen's egg. " It will then be fit for use, and must be put " into a proper pot, and covered with paper " or leather."

There are some who add an onion or crust of bread to the oil while boiling, in order to take off the greasiness; but the burning will sufficiently do that office, when properly managed.

Instead of Frankfort, or other kinds of black commonly used, the following composition may be substituted, and will form a much deeper and more beautiful black than can be obtained by any other method.

" Take of the deepest Prussian blue five " parts, and of the deepest-coloured lake and " brown pink each one part. Grind them " well with oil of turpentine, and afterwards " with the strong and weak oils in the man- " ner and proportion above directed."

The colours need not be bright for this purpoſe, but they ſhould be the deepeſt of the kind, and perfectly tranſparent in oil, as the whole effect depends on that quality.

Of the ſtuchum, *or perpetual ink of the ancients for engraven letters on ſtone.*

This ink (as it was called from its application) was formed by mixing about three parts of pitch with one part of lamp black, and making them incorporate by melting the pitch. With this compoſition, uſed in a melted ſtate, the letters were filled, and would, without extraordinary violence, endure as long as the ſtone itſelf.

SECTION VII.

Of ſecret inks.

A Great variety of methods have been invented for making ſecret letters, but the moſt common are to write with a colourleſs fluid, which may be made to aſſume the quality of ink, either by embrocating or moiſtening the paper containing the writing with ſome other fluid, or by putting it into a gentle heat, or by immerſing it in water. But many other expedients may be found for forming inviſible letters, which may be occaſionally rendered legible by applying the proper means, of which,

which, after ſpeaking of the more common methods, I will ſubjoin an inſtance or two.

For preparing inks, which may be made to appear occaſionally, the following methods may be purſued.

"Take an ounce of galls powdered, and "infuſe them three or four days in half a "pint of water. Pour off the clear fluid, "and diſſolve in it a dram of gum Arabic. "Write with this fluid, and, when it is de-"ſired to render the writing viſible, rub the "paper over with a ſolution of green vitriol or "copperas, formed by diſſolving half an ounce "of the vitriol in half a pint of water."

Or otherwiſe,

"Take two ounces of quick-lime, and one "ounce of orpiment, and add to them a pint "of water. Let them ſtand in a gentle heat, "often ſhaking the veſſel, for ſome hours, or "longer if it be convenient, and then pour "off the fluid. Make, in the mean-time, a "ſolution of ſugar of lead, by diſſolving three "drams of it in two ounces of water, and "with this ſolution write on paper what is "required. When it is deſired to render this "writing viſible, embrocate or rub over the "paper with the fluid taken off from the lime "and orpiment, and the letters will immediately "appear of a ſtrong blackiſh brown colour."

"Take any ſmall quantity of the calcined "ore of biſmuth, and diſſolve it in *aqua fortis*. "Then, having made a ſtrong ſolution of ſea "ſalt in water, add of this, to the ſolution

"of the bismuth in the *aqua fortis*, one-fourth "of its weight; evaporate then this mixture till "it be dry, or nearly so: there will then remain "a reddish salt, which, being again dissolved "in water, forms a sympathetic ink; for, if "letters or characters be written with it on "common writing paper, they will disappear "when dry and cold; but if the paper be "heated, they will shew themselves of a green "colour very legibly. On the paper's becom-"ing cold, they will again vanish, but may "be renewed at pleasure by heating it again. "If a solution of nitre or borax be used instead "of sea salt, the writing, when warmed, will "appear of a rose colour instead of green."

In order to make it more easy to write with the colourless fluids, they may be mixed with burnt corks, ivory black, or charcoal ground to a fine powder. This will render the writing thin and visible as if ink had been used; but the paper may be again made to appear blank, by rubbing off the black powder, which may be easily done by a soft brush or linen rag. Where, nevertheless, any black powder is mixed with the fluid, the gum Arabic, as directed in the first recipe, must be omitted, otherwise the powder will be so cemented to the paper as not to be easily taken off from it, without injuring the invisible writing under it.

Invisible letters, which may occasionally be rendered apparent, by holding the paper on which they are written to the fire, may be made by writing with the juice of lemons, or

of

of onions;—or with ſal Ammoniacum finely powdered and tempered with water;—or by the fluid which may be preſſed from the mixture of onion, urine, and ſalt, ground together till they become of an unctuous conſiſtence.

Letters may alſo be formed, which are inviſible till the paper on which they are written be immerſed in water. The eaſieſt method of doing which is by writing with a ſolution of roch allum, and, when it is deſired to have the letters appear, placing the paper in an horizontal ſituation in a baſon full of water, where, after it has remained ſome time, the writing will ſhew itſelf in a white character very diſtinctly. There are other methods of doing the ſame, but as they are more complex and troubleſome than this, it is needleſs to inſert them.

There is a very neat and eaſy method of uſing a blank writing, that may be made viſible occaſionally; which is, the applying the manner of gilding with the gold armoniac (as it was formerly called) to this purpoſe. It muſt be done by diſſolving gum Ammoniacum in water, to which ſome juice of garlic and a little gum Arabic ſhould be added, and then writing with the mixture, which writing may be rendered viſible at any time by breathing on the paper, and then laying a leaf of gold over the part written upon, which being compreſſed to the paper, and afterwards gently rubbed with a camel's hair bruſh, or a little cotton, will leave the writing perfectly gilt.

CHAP. II.

Of Cements.

CEMENTS require to be of very various compoſitions, and different with reſpect to the nature of the ingredients, according to the different manner in which they are to be applied, and the ſubſtances they are to conjoin. The kinds of cement uſed for common purpoſes paſs under the denomination of glues, ſizes, paſtes, and lutes, but ſome that are uſed for extraordinary occaſions retain only the general name of cements.

Of common glue.

Common glue is formed by extracting the gelatinous part of cuttings or ſcraps of coarſe leather, or the hides of beaſts; but this being carried on as a groſs manufacture by thoſe who make it their proper buſineſs, the giving a more particular account of the method practiſed would be deviating from the proper deſign of this work.

Preparation of iſinglaſs glue.

" Iſinglaſs glue is made by diſſolving beaten
" iſinglaſs in water by boiling, and, having
" ſtrained

"ſtrained it through a coarſe linen cloth, "evaporating it again to ſuch a conſiſtence, "that, being cold, the glue will be perfectly "hard and dry."

A great improvement is ſaid to be made in this glue by adding ſpirit of wine or brandy to it after it is ſtrained, and then renewing the evaporation till it gain the due conſiſtence. Some ſoak the iſinglaſs in the ſpirit or brandy for ſome time before it is diſſolved, in order to make the glue, and add no water, but let the ſpirit ſupply the place of it; but it is not clear, from trial, that either of theſe practices render the glue better.

This iſinglaſs glue is far preferable to common glue for nicer purpoſes, being much ſtronger, and leſs liable to be ſoftened either by heat or moiſture.

Preparation of parchment glue.

"Take one pound of parchment, and boil "it in ſix quarts of water till the quantity "be reduced to one quart; ſtrain off the fluid "from the dregs, and then boil it again till "it be of the conſiſtence of glue."

The ſame may be done with glovers cuttings of leather, which make a colourleſs glue, if not burnt in the evaporation of the water.

Preparation of a very ſtrong compound glue.

"Take common glue in very ſmall or thin "bits, and iſinglaſs glue, and infuſe them in

" as much ſpirit of wine as will cover them,
" for at leaſt twenty-four hours. Then melt
" the whole together, and, while they are
" over the fire, add as much powdered chalk
" as will render them an opake white."

The infuſion in the ſpirit of wine has been directed in the recipes given for this glue; but the remark on the uſe of it in the preceding article will hold good alſo in this, and the mixture may be made with water only.

Preparation of a very ſtrong glue that will reſiſt moiſture.

" Diſſolve gum ſandarac and maſtic, of
" each two ounces, in a pint of ſpirit of wine,
" adding about an ounce of clear turpentine.
" Then take equal parts of iſinglaſs and parch-
" ment glue, made according to the directions
" in the preceding article, and, having beaten
" the iſinglaſs into ſmall bits, as for common
" uſes, and reduced the glue to the ſame
" ſtate, pour the ſolution of the gums upon
" them, and melt the whole in a veſſel well
" covered, avoiding ſo great a heat as that of
" boiling water. When melted, ſtrain the glue
" through a coarſe linen cloth, and then
" putting it again over the fire, add about an
" ounce of powdered glaſs."

This preparation may be beſt managed in *balneo mariæ*, which will prevent the matter burning to the veſſel, or the ſpirit of wine from taking fire, and indeed it is better to uſe the

the ſame method for all the evaporations of nicer glues and ſizes; but, in that caſe, leſs water than the proportion directed ſhould be added to the materials.

A very ſtrong glue, that will reſiſt water, may be alſo made by adding half a pound of common glue or iſinglaſs glue to two quarts of ſkimmed milk, and then evaporating the mixture to the due conſiſtence of the glue.

Preparation of lip glue, for extemporaneouſly cementing paper, ſilk, and thin leather, &c.

"Take of iſinglaſs glue and parchment "glue, each one ounce, of ſugar-candy, and "gum tragacanth, each two drams. Add to "them an ounce of water, and boil the whole "together till the mixture appear, when cold, "of the proper conſiſtence of glue. Then "form it into ſmall rolls, or any other figure "that may be moſt convenient."

This glue being wet with the tongue, and rubbed on the edges of the paper, ſilk, &c. that are to be cemented, will, on their being laid together, and ſuffered to dry, unite them as firmly as any other part of the ſubſtance.

Of ſizes.

Common ſize is manufactured in the ſame manner, and generally by the ſame people, as glue. It is indeed glue left in a moiſter ſtate, by diſcontinuing the evaporation before it is brought

brought to a dry consistence, and therefore further particulars respecting the manufacture of it are needless here.—Isinglass size may also be prepared in the manner above directed for the glue, by increasing the proportion of the water for dissolving it, and the same holds good of parchment size. A better sort of the common size, which may be likewise made by treating cuttings of glovers leather in the same manner.

Of pastes.

Paste for cementing is formed principally of wheaten flour boiled in water till it be of a glutinous or viscid consistence.

It may be prepared of those ingredients simply for common purposes; but when it is used by book-binders, or for paper hangings to rooms, it is usual to mix a fourth, fifth, or sixth of the weight of the flower of powdered resin, and where it is wanted still more tenacious, gum Arabic, or any kind of size may be added.

In order to prevent the paste used for hanging rooms with paper, or where it is employed in any other way that may render it subject to such accidents, from being gnawed by rats and mice, powdered glass is sometimes mixt with it; but the most effectual and easy remedy is to dissolve a little sublimate, in the proportion of a dram to a quart, in the water employed for making the paste, which will hinder not only

only rats and mice, but any other kind of vermin and insects from preying on the paste.

Of lutes.

Lutes are cements employed for making good the joints of glasses put together, or other such purposes in chymical operations. In a general view, the preparation of them properly belongs to the art of chymistry only; but as they are nevertheless sometimes used in other arts, it may be expedient to shew here the manner of compounding them.

In the making good junctures, where the heat is not sufficient to burn paper or vegetable substances, the following mixture, which is easily made, will effectually answer the purpose. Take a mixture of linseed meal or wheaten flour and whiting, in the proportion of one part of the first to two of the last, tempered with a solution of gum Senegal or Arabic in water, and spread upon the joint, a narrow piece, smeared with the same, being put over it and pressed close. A piece of bladder smeared with gum water, or the glair of eggs, and fitted to the glasses over the joint; will also answer the same end; but in the rectification of spirit of wine, or other such volatile substances, where the waste made by the escape of the vapour may be material, a stronger lute formed of quick-lime, tempered to a proper consistence with drying oil, should be used. This mixture should be made at the time it is wanted,

as

as it very ſoon becomes dry and untractable, and great care muſt be taken, where it is employed, to manage the heat in ſuch manner that the vapour may not riſe ſo faſt as to heat the veſſels beyond the due point; for this lute renders the glaſſes joined together by it as one intire body, and will reſiſt the expanſive force of the vapour to ſo great a degree that the glaſſes will frequently burſt before it will give way.

Where lute is to be uſed in places liable to be ſo heated as to burn vegetable or animal ſubſtances, it may be thus compounded. Take two parts of green vitriol calcined to redneſs, one part of the ſcoria or clinkers of a ſmith's forge well levigated, and an equal quantity of Windſor loom or Sturbridge clay dried and powdered; temper them to a proper conſiſtence with the blood of any beaſt, ſome ſhort hair, of which the proportion may be as a twentieth part to the whole, being beaten up with them, and ſpread them over the juncture. In caſes of little importance, a compoſition of ſand, clay, and dung of horſes tempered with water may be uſed.

Preparation of cement for joining broken glaſſes, china, &c.

The cement which has been moſt approved for uniting glaſs, china, or earthenware, as alſo the parts of metalline bodies (where ſoldering is not expedient) is thus prepared.

"Take

"Take two ounces of good glue, and ſteep "it for a night in diſtilled vinegar; boil them "together the next day, and having beaten "a clove of garlic with half an ounce of ox-"gall into a ſoft pulp, ſtrain the juice through "a linen cloth, uſing preſſure, and add it "to the glue and vinegar. Take then of ſan-"darac powdered and turpentine, each one "dram, and of ſarcocol and maſtic pow-"dered, each half a dram, and put them "into a bottle with an ounce of highly-rec-"tified ſpirit of wine. Stop the bottle, and "let the mixture ſtand for three hours in a "gentle heat, frequently ſhaking it. Mix "this tincture alſo with the glue while hot, "and ſtir them well together with a ſtick "or tobacco-pipe, till part of the moiſture "be evaporated, and then take the compo-"ſition from the fire, and it will be fit for uſe. "When this cement is to be applied, it muſt "be dipt in vinegar, and then melted in a "proper veſſel with a gentle heat, and if "ſtones are to be cemented, it is proper to "mix with it a little powdered tripoli or chalk; "or, if glaſs is to be conjoined, powdered "glaſs ſhould be ſubſtituted."

I ſee no reaſon why common vinegar ſhould not be equally proper for this purpoſe with the diſtilled, nor indeed am I very certain that vinegar improves at all the cementing property of the compoſition.

For the uniting the parts of broken china or earthen-ware veſſels, as alſo glaſs where the rendering

rendering the joint visible is not of consequence, the following composition, which is much more easily prepared, may be substituted for the foregoing.

"Take an ounce of Suffolk cheese, or any
"other kind devoid of fat; grate it as small
"as possible, and put it, with an equal weight
"of quick-lime, into three ounces of skimmed
"milk: mix them thoroughly together, and
"use the composition immediately."

Where the broken vessels are for service only, and the appearance is not to be regarded, the joints may be made equally strong with any other part of the glass, by putting a slip of thin paper, or linen, smeared with this cement, over them, after they are well joined together by it. This method will make a great saving in the case of glasses employed for chymical, or other similar operations.

A cement of the same nature may be made by tempering quick-lime with the curd of milk, till it be of a due consistence for use. The curd, in this case, should be as free as possible from the cream or oil of the milk. On this account it should be made of milk from which the cream has been well skimmed off, or the kind of curd commonly sold in the markets, made of whey, and the milk from which butter has been extracted, commonly called butter-milk. This cement should be used in the same manner as the preceding; and they may be applied to stones, marble, &c. with equal advantage as the more com-

pound

pound one above given, and is much more eaſily and cheaply prepared.

Drying oil with white lead is alſo frequently uſed for cementing china and earthen ware; but where it is not neceſſary the veſſels ſhould endure heat or moiſture, iſinglaſs glue, with a little tripoli or chalk, is better.

Preparation of common cement for joining alabaſter, marble, porphyry, or other ſtones.

"Take of bees wax two pounds, and of "reſin one pound. Melt them, and add one "pound and a half of the ſame kind of matter "powdered as the body to be cemented is "compoſed of, ſtrewing it into the melted "mixture, and ſtirring them well together, "and afterwards kneading the maſs in water, "that the powder may be thoroughly incor-"porated with the wax and reſin. The pro-"portion of the powdered matter may be "varied, where required, in order to bring "the cement nearer to the colour of the body "on which it is employed."

This cement muſt be heated when applied, as muſt alſo the parts of the ſubject to be cemented together, and care muſt be taken, likewiſe, that they be thoroughly dry.

It appears to me that the proportion of the bees wax is greater than it ought to be; but I receive this recipe from too good an authority to preſume to alter it. When this compoſition is properly managed, it forms an extremely ſtrong

ſtrong cement, which will even ſuſpend a projecting body of conſiderable weight, after it is thoroughly dry and ſet, and is therefore of great uſe to all carvers in ſtone, or others who may have occaſion to join together the parts of bodies of this nature.

Of cements for rock-work, reſervoirs, and other ſuch purpoſes.

A variety of compoſitions are uſed as cements for purpoſes of this kind, in the application of which, regard ſhould be had to the ſituation where they are employed with reſpect to moiſture and dryneſs, as well as to the magnitude of the bodies to be conjoined together, or the vacuities or fiſſures that are to be made good.

Where a great quantity of cement is wanted for coarſer uſes, the coal-aſh mortar (or Welſh tarras, as it is called) is the cheapeſt and beſt, and will hold extremely well, not only where it is conſtantly kept wet or dry, but even where it is ſometimes dry and at others wet; but where it is liable to be expoſed to wet and froſt, this cement ſhould, at its being laid on, be ſuffered to dry thoroughly before any moiſture have acceſs to it; and, in that caſe, it will likewiſe be a great improvement to temper it with the blood of any beaſt.

This mortar or Welſh tarras muſt be formed of one part lime and two parts of well-ſifted coal-aſhes, and they muſt be thoroughly mixt by

by being beaten together; for, on the perfect commixture of the ingredients, the goodneſs of the compoſition depends.

Where the cement is to remain continually under water, the true tarras is commonly uſed, and will very well anſwer the purpoſe. It may be formed of two parts of lime, and one part of plaiſter of Paris, which ſhould be thoroughly well beaten together, and then uſed immediately.

For the fixing ſhells, and other ſuch nice purpoſes, putty is moſt generally uſed. It may be formed for this purpoſe of quick-lime and drying oil, mixed with an equal quantity of linſeed oil; or, where the drying quicker is not neceſſary, it may be made with lime and crude linſeed oil, without the drying oil.

The ſtone cement, prepared as above of the bees wax and reſin, is alſo an extremely good compoſition for this purpoſe. But reſin, pitch, and brick-duſt, in equal parts, melted together and uſed hot, are much the cheapeſt cement for ſhell-work, and will perform that office very well, provided the bodies they are to conjoin be perfectly dry when they are uſed.

CHAP. III.

Of ſealing-wax.

SECT. I. *Of ſealing-wax in general.*

SEALING-WAX is a cement formed of the reſins, gum reſins, or bodies of a ſimilar nature, tinged with ſome pigment to give the colour deſired. It ought to be capable of reſiſting moiſture, and of being melted or growing ſoft by a gentle heat, and becoming hard and tenacious on its again growing cold.

Moſt of the reſinous bodies, as ſeed and ſhell-lac, maſtic, ſandarac, gum gutta, gamboge, reſin, turpentine, and bees wax, have been applied to this purpoſe, and even ſulphur (though improperly, from its diſagreeable fumes on burning) has been added. There are two kinds of ſealing-wax in uſe, the one *HARD*, intended for ſealing letters, and other ſuch purpoſes, where only a thin body can be allowed :—the other *SOFT*, deſigned for receiving the impreſſions of ſeals of office to charters, patents, and other ſuch inſtruments of writing.

As there is with reſpect to the hardneſs of wax a better and more common kind in uſe, I will give

give one good recipe for each ſort, but ſhall omit all thoſe ingredients, which, though formerly uſed, produce no effect but what will be equally found in theſe ſimpler and cheaper compoſitions.

SECTION II.

Compoſitions of hard ſealing-wax of various colours.

Compoſition of the beſt hard red ſealing-wax.

"TAKE of ſhell-lac, well powdered, " two parts, of reſin and vermilion, " powdered alſo, each one part. Mix them " well together, and melt them over a " gentle fire, and when the ingredients ſeem " thoroughly incorporated, work the wax into " ſticks. Where ſhell-lac cannot be procured, " ſeed-lac may be ſubſtituted for it."

The quantity of vermilion, which is much the deareſt ingredient, may be diminiſhed without any injury to the ſealing-wax, where it is not required to be of the higheſt and brighteſt red colour; and the reſin ſhould be of the whiteſt kind, as that improves the effect of the vermilion.

Inſtead of reſin, boiled turpentine may be ſubſtituted with great advantage to the

qualities of the wax. The preparation of it is thus. "Take any quantity of Venice "turpentine; and, having put water to it, "boil them together till the turpentine be-"comes hard and ceafes to ftick to the "figures when cold."

Care fhould be taken, in making the wax, not to ufe too ftrong a fire in the melting the ingredients, and to remove them out of the heat as foon as they be well commixed; for, if any evaporation of the more volatile parts of the fhell of feed-lac, or refin, be fuffered, the wax is rendered proportionably brittle.

Compofition of a coarfer hard red fealing-wax.

"Take of refin two parts, and of fhell-lac, "vermilion, and red lead, mixt in the pro-"portion of one part of the vermilion to two "of the red lead, each one part, and treat "them according to the directions for the "foregoing compofition."

For a yet cheaper kind, the vermilion may be wholly omitted; and in the cafe of very coarfe ufes, the fhell-lac alfo.

Compofition of the beft hard black fealing-wax.

Proceed as for the beft hard red wax, only inftead of the vermilion fubftitute the beft ivory black.

Compofition

Compoſition of a coarſer hard black ſealing-wax.

Proceed as in the compoſition for the coarſer hard red wax; only, inſtead of the vermilion and red lead, ſubſtitute the common ivory black.

Compoſition of hard green ſealing-wax.

Proceed as in the above; only, inſtead of vermilion, uſe verdigriſe powdered; or, where the colour is required to be bright, diſtilled or chryſtals of verdigriſe.

Compoſition of hard blue ſealing-wax.

As the above; only changing the vermilion for ſmalt well powdered; or, for a light blue, verditer may be uſed; as may alſo, with more advantage, a mixture of both.

Compoſition of yellow hard ſealing-wax.

As the above; only ſubſtituting maſticot; or, where a bright colour is deſired, turpeth mineral, inſtead of the vermilion.

Compoſition of hard purple ſealing-wax.

As the red; only changing half the quantity of the vermilion for an equal or greater proportion of ſmalt, according as the purple is deſired to be bluer or redder.

SECTION III.

Compositions of soft sealing-wax.

Composition of uncoloured soft sealing-wax.

"TAKE of bees wax, one pound, of
" turpentine, three ounces, and of olive
" oil, one ounce. Place them in a proper
" veſſel over the fire, and let them boil for
" ſome time, and the wax will be then
" fit to be formed into rolls or cakes for
" uſe."

Composition of red, black, green, blue, yellow, and purple soft sealing-wax.

" Add to the preceding compoſition, while
" boiling, an ounce or more of any ingre-
" dients directed above for colouring the hard
" ſealing-wax, and ſtir the matter well about,
" till the colour be thoroughly mixt with
" the wax."

The proportion of the colouring ingredients may be increaſed, if the colour produced by that here given be not found ſtrong enough.

SECTION IV.

Of the manner of forming ſealing-wax into ſticks, balls, rolls, or cakes; and of perfuming it.

THE hard ſealing-wax is generally formed into ſticks, as the moſt expedient figure for ſealing letters, but for particular purpoſes it is ſometimes alſo made up in balls. The ſoft wax is promiſcuouſly wrought into rolls, or cakes; as either are equally ſuitable to the uſes it is applied to.

In order to the forming hard ſealing-wax into ſticks, a copper-plate, or ſtone, big enough to allow of its being rolled out to a due length, with a rolling-board, lined with copper or block tin, having a proper handle, is wanting, as likewiſe a ſmall portable earthen furnace or ſtove for burning charcoal. The copper-plate, or ſtone, muſt have a very ſmooth ſurface, and may be in dimenſions from two to three feet long, and about two feet broad; and it muſt be ſo fixt as to admit of its being kept of a moderate heat while it is uſed. The rolling-board may be about a foot long, and about eight or ten inches in breadth, and the lining of block-tin, or copper, ought to be poliſhed.

The furnace or ſtove, heated with charcoal, is alſo neceſſary for this purpoſe. It is made in the ſhape of a water pail, with bars near the bottom for ſupporting the coal, and notches at the top of the ſides for putting the wax over the fire; but it is needleſs to be more particular with regard to the conſtruction of theſe furnaces or ſtoves, becauſe they are to be had ready made at the earthen-ware ſhops.

The manner of uſing theſe ſeveral implements for the forming the wax into ſticks, is thus: Take a proper quantity of the wax out of the veſſel in which it is prepared, as ſoon as the ingredients appear duly commixt, and put it on the plate or ſtone; where, having drawn it out into a longiſh figure, it muſt be rolled with the board upon the plate or ſtone till it be of the thickneſs of which the ſticks are required. It muſt then be cut into proper lengths or ſticks, and will be fit to receive the *fire poliſh*. This *fire poliſh* is performed by putting one of the ſticks through the notches in the furnace or ſtove, over a fire of charcoal, which muſt be previouſly made in it, where the wax muſt be continued and turned about till it be ſo melted on the ſurface that it become fluid as water, and run to a perfectly ſmooth ſhining ſurface; when being taken out of the heat, and ſuffered to cool till it can be handled without affecting the poliſh, the other end muſt be put over the fire, and turned about in the ſame manner, till the whole be equally well poliſhed. The difficulty in

this

this operation lies in adjuſting properly the heat of the plate or ſtone on which the wax is rolled, ſo as to keep it of a due conſiſtence without ſoftening or melting it to ſuch a degree as to make it run or adhere to the plate or rolling-board, as alſo in regulating properly the fire in the furnace or ſtove for giving the fire poliſh. It is ſo difficult to fix a ſtandard for degrees of heat in theſe caſes, that no poſitive rules can be laid down in points of this nature; but the conduct muſt be left in a great meaſure to the judgment of the operator, who may, nevertheleſs, ſoon find by trial how to accommodate theſe matters properly.

Hard ſealing-wax may be formed into balls by putting a proper quantity on the plate or ſtone, and, having faſhioned it into a round form, rolling it with the board till it be ſmooth.

The ſoft wax is eaſily formed into rolls, or cakes, by pouring the melted maſs of the ingredients, as ſoon as they are duly prepared, into cold water, and then, while they are yet ſo ſoft with the heat as to admit of it, working them with the hands into any figure deſired.

Sealing-wax, either hard or ſoft, may be ſcented by moſt of the perfuming ingredients uſed for other purpoſes, and the quantity, choice, and proportion to each other of the reſpective ingredients, are intirely arbitrary and dependent on taſte or fancy. I will, however, give a recipe or two, to ſhew the manner of uſing each kind of ingredient, beginning with one of the moſt complex.

"Take

"Take in proportion to a pound of the "wax, of Benjamin half an ounce, of oil of "rhodium one ſcruple, of muſk ten grains, "and of civet and ambergriſe, each five "grains. Powder the Benjamin, muſk, civet, "and ambergriſe together, and then rub "the oil of rhodium among them, and when "the wax is ready to be wrought into ſticks, "ſprinkle in the mixture, and ſtir it well "about, that it may equally diffuſe among "the wax."

The following is however a ſimpler compoſition, but will be found much more grateful to moſt perſons, as there are many to whom the ſcent of muſk and civet are very diſagreeable.

"Take of Benjamin one ounce, of oil of "rhodium one ſcruple and a half, and of "ambergriſe five grains. Treat them as the "foregoing."

In perfuming the ſoft wax, the Benjamin may be omitted, as it requires a conſiderable heat to produce its ſcent to any effectual degree; but that alteration being made, either of the preceding compoſitions may be uſed; as in the caſe of the hard wax, and the ingredients may be added to the olive oil, before it be mixt with the bees wax and turpentine, or to the maſs after it has boiled a due time; or, to prevent the diſſipation of the ſcent which heat occaſions, the perfuming mixture may be worked or kneaded into the wax by the hand, keeping it ſoft by holding it in a gentle warmth before the fire.

PART

PART II.

Of engraving, etching, and ſcraping mezzotintos.

CHAP. I.

Of engraving in general.

BY engraving is to be here underſtood only that kind which relates to printing. In this ſenſe, it is the making, correſpondently to ſome delineated figure or deſign, ſuch concave lines on a ſmooth ſurface of copper or wood, either by cutting or corroſion, as render it capable, when charged properly with any coloured fluid, of imparting by compreſſion an exact repreſentation of the figure or deſign to any fit ground of paper or parchment.

The methods by which engraving is at this time performed is of three kinds;—by the graver or tool alone, which is in common language the only kind called *engraving*;—by corroſion with *aqua fortis*, which is generally called *etching*;—and by covering the ſurface of a copper-plate with lines, in ſuch man-

ner that the whole would produce the effect of black in an impreſſion, and then ſcraping or burniſhing away part of the lines, ſo as to cauſe the remainder to have the ſame effect as if they had been cut on the even ſurface, according to the delineation of any figure or deſign, which laſt kind is called *ſcraping in mezzotinto.*

Engraving with the tool was the kind originally practiſed, and it is yet retained for many purpoſes; for though the manœuvre of etching be more eaſy, and other advantages attend it, yet where great regularity and exactneſs of the ſtroke or lines are required, the working with the graver is much more effectual. On this account it is more ſuitable to the preciſion neceſſary in the execution of portraits, as there every thing the moſt minute muſt be made out and expreſſed, according to the original ſubject, without any licence to the fancy of the deſigner in deviating from it, or varying the effect either by that máſterly negligence and ſimplicity in ſome parts, or thoſe bold ſallies of the imagination and hand in others, which give ſpirit and force to hiſtory painting.

Etching is of a later invention (though not very modern) than engraving with the tool, of which it was at firſt only an imitation that was practiſed by painters and other artiſts who could much ſooner form their hand to, and attain a facility of working in this way than with the graver; but being then, neverthe-

leſs,

leſs, conſidered as a counterfeit kind of engraving, and therefore inferior to the other, it was cultivated in a very confined manner; the cloſeneſs of the reſemblance of the work to that performed by the tool, being made the teſt of its merit; and, conſequently, the principal object of aim in thoſe who purſued it. This ſervile confinement of the art of etching to the imitation of the original kind of engraving, was a great cauſe of retarding its advance towards perfection; as many of the moſt able maſters crampt their talents with the obſervance of it, which may be ſeen in the inſtances of Sadelers, Vilamene, Swanneberg, and particularly Le Boſſe, who, in his treatiſe on engraving, has laid it down as a principle, that the perfection of this kind conſiſts of the cloſe ſimilitude of the work with that done by the tool. This abſurd prepoſſeſſion has been ſince worn out; and the method of working with *aqua fortis* has been ſo far improved, that inſtead of being now deemed a ſpurious kind of engraving, it evidently appears the foundation of an excellence in many modern works, that could never have been produced without it. Since, though the neatneſs and uniformity of the hatches, which attend the uſe of the tool, is more advantageous with reſpect to portraits; yet the liberty and facility of the other manner gave a much greater opportunity to exerciſe the force of genius and fancy in hiſtory painting, where the effect of the whole, and not the minute exactneſs in finiſh-

ing

ing all the parts, conſtitutes the principal value. There are two manners practiſed of engraving in this way, the one with *hard* varniſh or ground, the other with a *ſoft*. The firſt was formerly much uſed, being better accommodated to the intention of imitating the engraving with the tool, as the firmneſs of the body of the varniſh gave more opportunity of retouching the lines, or enlarging them with the oval-pointed needles, called by the French *echoppes*, as was practiſed by Le Boſſe and the others for that purpoſe. The latter has now almoſt wholly ſuperſeded the uſe of the other, by the free and ſupple manner of working it admits of, which gives a power of expreſſion incompatible with the greater inflexibility of the hard varniſh, that confines the lines and hatches to ſuch a regularity and ſameneſs as gives a ſtiffneſs of manner and coldneſs of effect to the work.

The mixture of the uſe of the tool and *aqua fortis*, which are now both employed together in many caſes, has however given that perfection to engraving which it bears at preſent. The truth and ſpirit of the outline that the method of working with *aqua fortis* affords, and the variety of ſhades which the different kinds of black producible in this way, as well as other means of expreſſing the peculiar appearance and character of particular ſubjects, furniſh what was defective in the ſole uſe of the tool; while, on the other hand, the exactneſs and regularity of the lines which are required

quired for finiſhing many kinds of deſigns, are ſupplied by the graver; and by a judicious application of both, that complete finiſhing is obtained which either of them, alone, muſt neceſſarily want.

The *ſcraping mezzotintos* is the laſt-invented manner of engraving, and may be juſtly eſteemed a very valuable acquiſition to the art. As the great ſoftneſs of the effect, which may be had along with the ſtrongeſt relief, fits it extremely to the purpoſes of portraiture, particularly in the caſe of women or younger men, and gives it much more the qualities of painting than either of the other kind, an effort has been made to apply this art to a purpoſe of yet much greater conſequence; which is, by printing with ſeveral colours to produce pictures not eſſentially different from thoſe that are painted. The invention of this art is aſcribed to Mr. Le Blond, the only perſon who has hitherto brought it into practice with ſucceſs; but he advanced it ſo far as to ſhew, by the ſpecimens he gave, that it was capable of being carried to great perfection, and of being the means of producing good pictures of eminent perſons at a much leſs expence than by the method of painting.

Engraving, with a view to printing, is in general at preſent practiſed on copper or wood. In this part of the world all deſigns ſubſervient to more elegant work are engraved on copper, and wood is only uſed for very coarſe

or ſimple purpoſes. But the Chineſe, who intermix printing and painting much more than we do, ſeem to make a very advantageous uſe of the engraving on wood, in the execution of which they doubtleſs exceed what we have any conception of here, and produce very fine outline ſketches, which greatly aſſiſt in the painting, even in very large pieces, by means of wooden prints. It were to be wiſhed, therefore, that the engraving on wood was more encouraged and cultivated here; eſpecially as paper hangings, to the manufacture of which it is greatly ſubſervient, is becoming now a very conſiderable article of trade, and at preſent poſſeſſed by ourſelves alone.

CHAP. II.

Of the choice and preparation of copper-plates for engraving.

PLATES intended for engraving ought to be formed of the beſt copper, which can be diſtinguiſhed only by examining it with regard to the qualities requiſite to the conſtituting it good. Theſe qualities are, that it ſhould be very malleable, that is capable of being ſpread with the hammer, or ſuffering itſelf to be rolled or drawn out to the niceſt or

ſmalleſt

ſmalleſt pieces; that it ſhould nevertheleſs be firm, and reſiſt even to ſome degree of hardneſs, provided no ſhortneſs of grain or brittleneſs attend, but that it be perfectly ductile; and that it be free from any veins, ſpecks, or diſſimilar parts, but of an equal texture through the whole. The redneſs of copper is a preſumptive mark of its being good, but not an infallible one; for though it is, in general, a proof of the purity of the copper, yet it does not evince that the qualities may not be injured by too frequent fuſions, or the calcinations it may have undergone, if, as is frequently the caſe, it has before been employed in forming ſome utenſil.

The copper being choſen, it muſt be fabricated into plates of the ſize demanded, the thickneſs of which may be in the proportion of a line to plates that are a foot by nine inches. Theſe plates muſt then be well forged and planiſhed by a brazier, which ſhould be done cold; for by managing this operation well, the poroſity of the copper may be greatly removed, which is for the moſt obvious reaſons of great conſequence. When a plate is forged, it ſhould be examined which ſide is the moſt even, and the leaſt flawed or cracked, and then the poliſhing may be thus performed.

Put the plate upon a board leaning obliquely, and in the bottom of which two nails, or points of nails, are fixed, to keep it from ſliding off. Then take a large piece of grind-ſtone dipt in clean water, and rub it very ſtrongly once in

every part lengthways, and then the ſame breadthways, keeping it moiſt with water, and repeat this operation till no hollows appear, nor the leaſt mark made by the hammer in forging, or any other flaws, holes, or inequalities. After this, take a piece of good pumice-ſtone, and rub the plate with it in the ſame manner as was done before with the grind-ſtone, till all the ſcratches and marks made by the grind-ſtone may, by the pumice-ſtone, be likewiſe taken away, and then waſh it thoroughly clean. The ſcratches and marks of the pumice-ſtone ſhould then be taken out by rubbing the plate in the ſame manner with a piece of oil-ſtone, till all the marks and ſcorings of the pumice-ſtone be taken out; and the plate ſhould be then again waſhed with water till it be perfectly clean. A proper kind of coal muſt in the mean-time be prepared for finiſhing the preparation of the plate, which muſt be done in the following manner.

Take three or four large coals of ſallow wood, ſound and without clefts, and place them together in a fire made on a hearth, and cover them with other burning coals, heaping a quantity of red-hot aſhes upon them. In this manner let them remain, being ſubject to only a ſmall acceſs of air, for about an hour and a half; but the time ſhould be greater or leſs according to their ſize, that the fire may penetrate into the innermoſt part of them, and expel all the ſmoke that can be driven out; to be certain of which, it is better they ſhould

ſhould ſtay in the fire rather longer than is neceſſary, than that the time ſhould be unduly ſhortened. When they are fit to be taken out, a veſſel of water large enough to hold them ſhould be prepared, and they ſhould be inſtantly thrown into it, and left there to extinguiſh and cool. For this purpoſe ſome uſe urine inſtead of water; but there is no difference, unleſs in the diſagreeable ſmell of the latter. The coals being thus prepared, pick out one, or a part of one, ſufficiently large, firm, and free from clefts, and holding it faſt in the hand ſet one of the corners againſt the plate, and rub it, but without obſerving any particular manner, to take out the marks or ſcorings of the oil-ſtone. If nevertheleſs the coal glide on the ſurface, and take no effect, it is a proof of its not being fit for the purpoſe, and another, that is not ſo faulty, muſt be uſed inſtead of it. This fitneſs may be thus diſtinguiſhed, that the coal, if good, being wet, and rubbed on the copper, will ſeem rough, and grate it with a low murmuring noiſe. When a good coal is obtained, the operation muſt be continued till not the leaſt ſcoring, flaw, or hole whatever appear. But if the coal itſelf, as will ſometimes happen, be too hard, and leaves traces or ſcores of its own forming, a ſofter one muſt be choſen, and uſed in the ſame manner as the firſt, to remedy the defects of it, and to procure a perfectly clear and even ſurface on the plate.

This is the method directed by Le Boſſe. But the end may be better anſwered, by firſt wearing out the marks of the planiſhing hammer by rubbing with emery finely ground, and then, the plate being waſhed clean, bruſhing it over with the refiner's *aqua fortis*, as below directed to be prepared; which muſt be ſuffered to lie on till the ebullition it produces begins to decreaſe, and then waſhed off by immerſing the plate in water; when it will be found to be brought to a better condition to take the burniſh with more certainty, than by the laborious uſe of ſo many ſtones and the coal.

The plate being brought to this ſtate, the poliſhing muſt be finiſhed with a ſteel burniſher, with which it muſt be ſtrongly rubbed. The beſt method of moving the burniſher is not to work it lengthways, or breadthways, but in a diagonal direction, or from corner to corner; which will more effectually take out all remains of the former ſcorings or lines. The copper muſt be thus burniſhed till it be as bright as looking-glaſs in every part; but if, when the reſt is thus bright, ſome particular ſpots appear dull, or any lines remain, ſuch faulty parts ſhould be again worked with the burniſher, till the whole be uniformly ſhining.

When the plates are deſigned for etching, being thus finiſhed with the burniſher, they ſhould be well waſhed with clean water, and then dryed by the fire. After which they

ſhould be wiped dry with a linen cloth; and to be certain that there may be no kind of greaſe upon them, they ſhould be rubbed over with the crumb of very ſtale bread. And the ſcraping very ſoft chalk over it, and rubbing the plate well with it, is a very ſure means of prevention of either any greaſe, bread, or other foulneſs whatever remaining. There is one very certain method of trying whether the plate be perfectly well poliſhed, or not. This is, to rub it over with the printing ink, and proceed to take (or pull off, as it is called) a proof in the ſame manner as if it had been engraved; which, if the plate make not the leaſt impreſſion on the paper, but leave it intirely white as before it paſſed through the preſs, ſhews the poliſhing is complete. But if, on the other hand, any lines appear to be printed, it is evident the plate is faulty, and muſt be poliſhed over again, either by the other means, or the burniſher, as the ſtrength of the lines may indicate occaſion. If, however, the plate be deſigned for etching, great care ought to be taken, after this method of trial, to cleanſe it thoroughly from the oil of the printing ink, or any other foulneſs.

CHAP. III.

Of engraving with the tool or graver.

SECT. I. *General nature of engraving with the graver.*

ENgraving with the tool or graver, which, as has been obſerved before, was the original kind, is performed by cutting lines or hatches on the poliſht ſurface of a copper-plate, by inſtruments of ſteel adapted to that purpoſe.

It is much the moſt difficult manner of engraving that can be undertaken, requiring greater practice and command of hand, in order to ſucceed in any diſtinguiſhed degree, than either etching, or ſcraping mezzotintos. Its ſuperior fitneſs for many purpoſes will, nevertheleſs, always continue the uſe of it; and it is indeed abſolutely neceſſary, that they, who purſue etching with a view to any ſubjects of conſequence, ſhould underſtand, and, in ſome meaſure, be executively maſters of the management of the tool; for greater deſigns, finiſhed wholly by *aqua fortis*, will want many beauties, and advantages, that may be obtained by the aid of this.

In engraving with the tool, there is a great difference obſervable in the manner even of thoſe

thoſe who have been held in eſteem. Some appear to have a great facility in the uſe of the graver, others to have a much more laborious and ſtiff way; which, with whatever merit of other kinds it may be attended, is yet a defect. But, on the other hand, ſome maſters have ſeemed to place ſo much in this facility as to neglect outline, expreſſion, and even the clair-obſcure of the pictures after which they engraved. In what particulars this faulty or laborious ſtiffneſs conſiſts, we ſhall have occaſion to obſerve when we examine the peculiar difference of the methods of engraving with the graver.

SECTION II.

Of the apparatus, or ſet of inſtruments neceſſary for engraving with the tool.

THE principal inſtruments uſed in engraving with the tool are gravers, burniſhers, an oil-ſtone, and a cuſhion for bearing the plates.

Gravers are made in ſeveral forms with reſpect to the points, ſome being round, others ſquare, and a third kind lozange. The round pointed is beſt for ſcoring lines, the ſquare for cutting broad and deep, and the lozange for more delicate and fine ſtrokes and hatches.

Le Boſſe recommends, as the moſt generally uſeful, ſuch as are of form betwixt the ſquare and lozange, and adviſes that they ſhould be of a good length, ſmall towards the point, but ſtronger upwards, that they may have ſtrength enough to bear any ſtreſs there may be occaſion to lay upon them. For if they be too ſmall, and mounted high, they will bend, which frequently cauſes their breaking, eſpecially if they be not employed for very ſmall ſubjects. The gravers ſhould be made of the beſt ſteel, which muſt be drawn out into ſmall rods, with a charcoal fire. Theſe rods ſhould be cut into the lengths choſen for the graver, and then ſoftened in their temper, by heating in a charcoal fire, and ſuffering them to cool very ſlowly, either by continuing them in the fire till it extinguiſhes, or taking part of the burning embers out of the fire, and burying the lengths of rod in them, till the whole grow cold. They ſhould then be filed into the form deſired, and afterwards brought back to a hard temper, by heating them red hot, and, while they are ſo, thruſting the end into a lump of ſoft ſoap. But, in doing this, great care ſhould be taken to put them into the ſoap with a true perpendicular direction; for, if they be turned in the leaſt obliquely, the graver will warp, and be crooked. If the temper of the graver be found too hard after this treatment, and prevent the whetting it properly to an edge, it may be ſoftened by taking a large burning piece of charcoal,

charcoal, and laying the end of the graver on it till it begin to grow yellow, and then thrufting it into a lump of tallow, or dipping it in water; but, if water be ufed, the graver muft not be too hot, or it will not be foftened by this treatment. It may be diftinguifhed whether the graver be tempered to a proper hardnefs or not by touching the edge of it with a file, which, if any effect follow from it, proves the temper too foft. The beft proof of too great hardnefs is the breaking of the point in the engraving; after which, neverthelefs, if a new edge be made by whetting the graver, it will be frequently found very good without any other alteration. The graver being thus formed, muft be mounted in a proper handle, the fize of which fhould be adapted to that of the hand of the perfon who is to ufe it, and then the graver muft be whetted on the oil-ftone till it have a due edge. The oil-ftone, though a very neceffary implement in engraving, is too well known to require any defcription here; I will therefore proceed to fhew how the gravers muft be finifhed by being whetted on it. The ftone muft firft have a few drops of olive oil put on it. Then one of thofe fides of the graver which form the angle that is to give the edge for cutting the plate fhould be laid flat upon it, and being preffed firmly down by the forefinger extended upon it, it muft be rubbed by pufhing it forwards, and drawing it back till the fide be very flat and even. This treatment

ment muſt be likewiſe repeated with regard to the next ſide, till a very ſharp edge be formed for about an inch of the length of the graver. When the graver is intended to have a lozange point, it muſt be ſet obliquely on the ſtone, with the edge which is already formed uppermoſt; and in this poſition it muſt be wetted till the end applied to the ſtone be flat, notwithſtanding the obliquity of the poſition, and produce a ſlope with reſpect to the other ſides, ſo as to form a lozange. If the face of the graver be too large, it may be remedied by taking off a little from the two ſides which do not form the edge. Care ſhould be taken that the ſides of the graver be wetted very flat, with the edge riſing a little towards the extremity of the point, in order that it may the more eaſily be diſengaged from the copper, and alſo that the point be ſharp if the work be deſired to be fair and lively, for a blunt graver can do nothing but ſcratch; and to take off the roughneſs left by the oil-ſtone, it is practiſed to ſtrike the point of the graver into a piece of box or any hard wood, which will anſwer that end. The ſharpneſs of the point of a graver can ſcarcely be diſtinguiſhed by the eye, and it is therefore uſual to try it on the nail, where it will be eaſily perceived whether it cuts keenly or not. After the graver is mounted with a proper handle, and whetted, it is neceſſary to cut off that part of the knob of the handle which is in a line with the edge of the graver, in order to render the

the whole of it ſo flat on that ſide that it may be applied in any direction to the plate.

Burniſhers are another kind of inſtruments uſed to aſſiſt in the engraving on ſome occaſions as well as to poliſh the plates. Thoſe uſed for engraving may be ſuch as are made for other purpoſes, which, being to be procured every where, do not require a further deſcription here. The principal application of them in engraving, beſides their uſe in poliſhing the plates, is to take out any ſcratches, or accidental defacings, that may happen to the plates during the engraving, or to leſſen the effect of any parts that may be too ſtrongly marked in the work, and require to be taken down.

A cuſhion, as it is called, is likewiſe generally uſed for ſupporting the plate in ſuch manner that it may be turned every way with eaſe. It is a bag of leather filled with ſand, which ſhould be of the ſize that will beſt ſuit the plates it is intended to bear. They are moſt commonly made nine inches ſquare, and three or four in thickneſs.

SECTION III.

Of holding and handling the graver.

THE graver being prepared, and the part of the handle next the ſteel properly cut,

cut, it muſt be held in the hand, ſo that on applying it to the plate the edge may be towards it. The manner of holding it is to let the handle be in the hollow or palm of the hand, with three fingers compreſſing it on one ſide, and the thumb on the other, and the fore-finger extended upon it towards the point oppoſite to the edge, ſo that the graver, being applied flatly to the plate, may be guided by the motion of the hands, and the point preſſed with greater or leſs force, as may be required, by the fore-finger which bears upon it, in ſuch manner that lines may be cut which will be ſmaller at the extremities, and deeper in the middle; but care muſt be taken that the fingers do not embrace the handle in ſuch manner as to interpoſe and hinder the graver from being carried level on the plate, which would cauſe the lines to be rugged, unequal in different places, and deeper than they ought to be. It is neceſſary, likewiſe, that the graver be firm in the hollow of the hand, the knob of the handle bearing againſt the part of the hand which forms the joint with the arm, that a greater force may be exerted againſt the reſiſtance of the copper, particularly in making large and deep hatches.

SECT.

SECTION IV.

Of the general manner of managing the graver.

THE cuſhion, made as above directed, being laid on the table firmly fixt, the plate muſt be put upon it, and the graver being held in the hand, according to the inſtructions before given, the point muſt be applied to the plate, and moved in the proper direction for producing the figures of the lines intended. It muſt be obſerved, in forming ſtraight lines, to hold the plate ſteady on the cuſhion, and, where they are to be finer, to preſs more lightly, uſing greater force where they are to be broader and deeper. In making circular or other curve lines, the hand and graver muſt be held ſteady, with the arm reſting upon the table, and the plate moved upon the cuſhion under the graver, ſo that as each proper part paſſes the point, the figure intended may be cut upon it; for crooked and winding lines cannot be produced with the ſame neatneſs and command by any other means. After part of the work is engraved, it is neceſſary to ſcrape it with the ſharp edge of a burniſher or graver, paſſed in the moſt level direction over the plate, to take off the

the roughneſs formed by the cutting of the graver; but great care muſt be taken not to incline the edge of the burniſher, or tool uſed, in ſuch manner that it may take the leaſt hold of the copper, as it would otherwiſe produce falſe ſtrokes or ſcratches in the engraving; and, that the engraved work may be rendered more viſible, it may afterwards be rubbed over with a roll of felt dipt in oil. In uſing the graver, it is neceſſary to carry it as level as poſſible with the ſurface of the plate; for otherwiſe, if the fingers ſlip betwixt them, the line that will be produced, whether curve or ſtraight, will become deeper and deeper in the progreſs of its formation, which entirely prevents ſtrokes being made at one cut, that will be fine at their extremites, and larger in the middle, and occaſions the neceſſity of re-touching to bring them to that ſtate; for this reaſon, it is very neceſſary for thoſe who would learn to engrave in perfection, to endeavour, by frequent trials, to acquire the habit of making ſuch ſtrokes, both ſtraight and curving, by lightening or ſinking the graver with the hand, according to the occaſion. If after finiſhing the deſign any ſcratches appear, or any part of the engraving be falſely executed, ſuch ſcratches or faulty parts muſt be taken out by the burniſher, and further poliſhed, if neceſſary, by a roll of felt and oil. The plate may be cleanſed again, as at firſt, by crumbs of bread and chalk, in order that the obliterated part may

may be reſtored, where there is occaſion, by re-ingraving it.

The plate being thus engraved, it is proper to take off the edges, by uſing firſt a rough file, and afterwards a ſmoother, and to blunt the corners a little by the ſame means; after which, the burniſher ſhould be paſſed over the filed places to take away the ſcorings, that no part of the printing ink may be retained in them.

SECTION V.

Of the particular manners of engraving.

THERE are ſome who ſhew a facility in engraving, and others that have a laborious manner, and ſome alſo affect to croſs their ſtrokes very much in the lozange manner, while others make them intirely ſquare. The free and eaſy manners here meant, are thoſe of Goltzius, Muller, Lucas, Kilian, Melian, and ſome others. They ſeem, on many occaſions, to apply themſelves only to ſhew, by the turning of the ſtrokes, that they were maſters of the graver, without giving themſelves any trouble about the juſtneſs of the outline, expreſſion, or even the effect of the clair-obſcure which was found

found in the drawings or pictures after which they engraved.

The manner which I deem laborious is, where there are an infinite number of lines and points, or dots, confounded with each other, and diſpoſed without order, which have the reſemblance rather of a drawing, than the appearance of an engraving.

The ſtrokes ſhould never be croſſed too much in a lozange manner, particularly in fleſh; becauſe ſuch croſſings form ſharp angles, which give the diſagreeable effect of lattice-work, and takes away from the eye the repoſe which is agreeable to it in all kinds of pictureſque deſigns. The ſtrokes ought not to be ſo much croſſed in this manner, except in the caſe of clouds, tempeſts, repreſentations of the waves of the ſea, and the ſkins of hairy animals, or of the leaves of trees, where it may be very well allowed of.

The manner betwixt the ſquare and lozange is much more uſeful and agreeable to the eye, but it is more difficult to purſue, as the inequality of the ſtrokes ſhews itſelf more. But in avoiding the lozange, it is not however proper to go intirely into the ſquare, for that gives too much of the hardneſs of ſtone.

In the manner of guiding the ſtrokes, the action of the figures, and of all their parts, ought firſt to be conſidered. It ſhould be next obſerved, how the parts come forwards to, or go back from, the eye. The graver ſhould

ſhould then be guided according to the riſings or hollows of the muſcles and folds, ſpreading the ſtrokes more aſunder under the lights; bringing them cloſer together in the ſhades, and alſo at the extremity of the outlines, to which the ſtrokes of the graver muſt be carried, that they may not appear jagged; and lightening the hand in ſuch manner that the outlines may be formed and terminated without being cut or hard. Examples of this may be found in the works of the famous Edclinck, who greatly poſſeſſed this talent.

Although ſtrokes are broken off at the place of the muſcles, whether it be to form them, or to produce the effect more commodiouſly, there ſhould, nevertheleſs, be always preſerved a certain connection or link of one with the other, that the firſt ſtroke may frequently ſerve, by its return, for the ſecond. This diſplays a freedom; and the engraving that is ſo managed is more beautiful, in proportion as it appears to be done with more facility.

The ſtrokes ſhould, however, be always made to run as naturally as poſſible, avoiding wild turnings, which are more the effect of caprice than reaſon. At the ſame time care muſt be taken not to fall into a ſtraight direction, which many do when they ſtrive to engrave neatly; becauſe it is more eaſy for them to puſh forward the ſtrokes of the graver, that are but little turned, than

to guide them according to the riſings and hollows of the muſcles, which they do not underſtand, from their want of ſufficient knowledge in deſign.

In engraving the hair and the beard the principal grounds ſhould be firſt laid, and then the chief ſhades ſhould be ſketched, leaving the ſtrong lights, that, if it be deſired, in the finiſhing them they may be covered to the extremity. This kind of ſketching ſhould be done, as it were, in a careleſs manner; that is to ſay, with few ſtrokes, and thoſe even unequal with reſpect to each other, to have room in the finiſhing to mix ſmaller ſtrokes in the vacancies, which this inequality will produce. This manner ſeems much leſs hard than where every hair is diſtinguiſhed, and as much effect as poſſible ought to be made by every ſtroke, eſpecially when the figures are not very large. For this reaſon none ought to be introduced but ſuch as have the neceſſary force; and if ſome ſecond ſtrokes are, however, run at the ſides of the ſhades, to mix and give them more union with the fleſh, they ſhould be very ſmall.

When ſculpture is to be repreſented, the work ought never to be made very black; becauſe, as edifices are commonly built either of ſtone or white marble, the colour, being reflected on all ſides, does not produce browns, as in other ſubſtances. White points muſt not be put in the pupils of the eyes of figures, as in engraving after paintings, nor muſt the hair

or

or beard be repreſented as in nature, which makes the locks appear flowing in the air. This would be to do things contrary to truth; becauſe in ſculpture there can be no ſuch appearances.

In engraving cloths of different kinds, it ought to be obſerved, that linen ſhould be done with ſmaller and cloſer lines than other ſorts. It muſt be all executed with ſingle ſtrokes; or, if there be two admitted, it ſhould in ſome ſmall ſpots only; and theſe ſhould be only in the ſhades, to give an union and hinder a rawneſs which might reſult from the oppoſition, when it was either upon, or cloſe to, other draperies, or any brown bodies, croſt with many ſtrokes.

When white woollen cloth is in queſtion, it ought to be engraved wide accordingly, as the ſtuff may be coarſe or fine, but with two ſtrokes only. It may be objected, that inſtances may be found, where there are three; but the anſwer is, that it has been done only for diſpatch. If the difference in ſtuffs can be made to appear, it renders the work more agreeable; but the trouble in doing it is very great, and the labour greatly multiplied.

There remains only to remark, with regard to the engraving cloths, that on all occaſions, when there ariſes a neceſſity of croſſing the ſtrokes, the ſecond ſhould be ſmaller than the firſt, and the third than the ſecond, as the work will have much more ſoftneſs for it.

Shining ſtuffs ought to be engraved more hard, and more ſtraight than others; becauſe, as they generally are of ſilk, they produce folds that are flat and broken; particularly if they be ſattin, which is ſtiff on account of its gummineſs. Theſe ſtuffs ſhould be expreſſed with one or two ſtrokes, according as their colours are bright or brown. Betwixt the firſt ſtrokes others ſmaller muſt be joined, which are called *entre-deux*. Velvet and pluſh are expreſſed in the ſame manner, with the *entre-deux*. The only difference ſhould be, that the firſt ſtrokes ought to be much larger and fuller than thoſe of other ſtuffs, and the ſecond ſhould be ſmaller, but ſtill retaining the fulneſs of the firſt.

Metals, as vaſes of gold, or of copper, or armour of poliſht ſteel, ſhould be likewiſe treated in the ſame manner, with the *entre-deux*; and that which produces the ſhining appearance, is the oppoſition of the browns with the lights.

With relation to architecture, perſpective informs us, that the ſtrokes which form the rounding objects muſt tend to the point of ſight.

When whole columns occur, it is proper to make out the effect as much as poſſible by perpendicular ſtrokes, becauſe that in croſſing them, according to the roundneſs, the ſtrokes which are near the capitals being oppoſed to thoſe which are in the place of the baſe, make a diſagreeable effect at the height of the eye;

at leaſt if ſo great a diſtance be not ſuppoſed as renders the objects almoſt parallel.

In the caſe of landſkip, thoſe who are verſed in the uſe of *aqua fortis* may make the outlines with it, particularly of the eaves of trees. This is a little more expeditious, and will anſwer the purpoſe very well, provided diſcretion be uſed in not doing it too ſtrongly, and that, in finiſhing with the graver, the work of the *aqua fortis* may not remain diſtinguiſhable, nor any way take off from the ſoftneſs.

To do it well, it is proper to conform to the manner of Auguine Carrache, who did it admirably by touches; but a higher finiſhing may be made according to the occaſion. Villamene and John Sadelers, have alſo ſucceeded very well in touching; as likewiſe Cornelius Cort, who has engraved many things after Merian very finely; and who, indeed, may be taken as a ſufficient guide.

In engraving mountains, the ſtrokes ought to be frequently diſcontinued, and broken, for ſharp and ſcraggy objects, and they ſhould be ſtraight, in the lozange manner, and accompanied with ſome long points or dots. Where rocks are in queſtion, the ſtrokes ſhould be croſſed with others more ſquare, and evenly, becauſe the flint is generally more poliſhed.

The diſtant objects, which are towards the horizon, ſhould be kept very tender, and be but ſlightly charged with black, although the maſs appear brown; as it may happen to ſome ſhades, ſuppoſed to be cauſed by acci-

dents of clouds that intercept the light of the ſun. Becauſe theſe ſhades and lights, however ſtrong they may appear, are always weak in compariſon of thoſe of the figures, or other objects, which are found on the fore-ground of the picture, from the great diſtance, and the air that is interpoſed before theſe objects.

In the repreſentation of waters the ſtate of them is to be conſidered; ſome being calm and ſtill, and others turbulent and agitated; as the ſea by the winds, and caſcades by the fall. With reſpect to calms, they are beſt repreſented by ſtrokes that are ſtraight and parallel to the horizon, with *entre-deux* that are ſmaller, omitting ſuch places, as, in conſequence of gleams of light, make the ſhining appearance of water. The form of objects reflected, or advanced near in diſtance upon the water, or upon the banks of it, are expreſſed by the ſame ſtrokes, re-touched more ſtrongly or faintly as occaſion may require it; and even by ſome that are perpendicular, and ſuch reflected objects are more or leſs diſtinctly made out accordingly, as they are found nearer, or more diſtant from, the fore-ground of the picture. If they be trees, they ought to be marked out by an outline, particularly if the water be clear, and upon the fore-ground of the picture, becauſe the repreſentation which the water makes of them is as diſtinct as the trees themſelves.

For

For water agitated, as in the waves of the ſea, the firſt ſtrokes ought to follow the figure of the waves, and the croſs ſtrokes ought to be very much lozange. If water fall down any rock with rapidity, the ſtrokes ſhould follow the fall, being mixt with *entre-deux*, and the ſhining ſpots which are found in the places, where the light ſtrikes perpendicularly, ſhould be very vivid, particularly if it be on the fore-ground.

In engraving clouds, play ſhould be given; the graver ſhould ſport, when they appear thick and agitated, in turning every way according to their form and their agitation. If the clouds produce ſhades, which render it neceſſary to put two ſtrokes, they ought to be croſſed more lozange than the figures, becauſe that gives a certain tranſparency that is very ſuitable to thoſe bodies which are compoſed only of vapours; but the ſecond ſtrokes ſhould be predominant over the firſt.

The flat clouds, that loſe themſelves inſenſibly in the clear ſky, ſhould be made by ſtrokes parallel to the horizon, a little waving conformably to the thickneſs which may appear. If ſeconds be required, they ſhould be more or leſs lozange; and when they are brought to the extremity the hand ſhould be ſo lightened that they may form no outline. The flat and clear ſky is repreſented by parallel ſtrokes; but very ſtraight, without the leaſt turning.

SECTION VI.

Of engraving in great.

FOR great works, that is, when the figures are of confiderable fize, they ought to be engraved wide; the ftrokes fhould be fteady and full large, and continued as far as they can; that is to fay, they fhould not be broken off, till they come to the places of the mufcles or folds which abfolutely require it. The fame, indeed, ought to be done in the cafe of fmall works, to fhew that the execution was in an eafy manner, and without much labour. If the ftrokes are to be retouched, which cannot be avoided in many places, efpecially in the fhades, where the force and union of the picture are to be well preferved, it fhould be done the contrary way to that in which it was fketched, and with a graver more lozange. This adds much to the life and neatnefs of the work.

There ought not to be too much work made upon the lights; but they fhould be gone over flightly, and with few ftrokes; or, in other words, the lights fhould be loofely touched, and only in demi-teints. If they be finifhed to the higheft degree, they fhould be ftill kept very clear; for if, on the contrary, they be too black, it diminifhes and prevents the effect, becaufe it is extremely difficult to find

find browns in the ſhades to ſupport them, ſo as to give a ſufficient force and roundneſs. If the work be after original drawings, they ought to be firſt engraved with great lights and great ſhades; becauſe, let them be never ſo much finiſhed, there cannot be ſo many particulars to expreſs as in the caſe of painted pictures, which require likewiſe much more care and labour on the ſcore of their different colours.

It may be objected, perhaps, that it is impoſſible to imitate colours, as there is no medium for it in engraving but black and white. When, however, I ſpeak of imitating them, I do not pretend to expreſs the difference betwixt green and blue, nor betwixt red and yellow, nor of any of the reſt in particular, but only to imitate the maſſes; and Wovermans, Bolſwert, and ſome others, have done this with ſucceſs when they have engraved after Rubens. Works, in which this matter ſhall be executed by an able engraver, who is maſter of the principles of his art, will, undoubtedly, be much more pleaſing, and have a much finer effect than where it is wanting. It is proper, therefore, the engraver ſhould be intelligent and ſkilful, becauſe he ſometimes meets with colours that are light, on others which are light alſo, where, conſequently, no effect can be produced but by the difference of the hue. This makes what is called *a corps perce*, an accident very carefully to be avoided, becauſe it takes away all means

means of judging of the clair-obſcure. It is neceſſary, likewiſe, to take care not to deſtroy the principal lights, by affecting to imitate colours too much, particularly in the caſe of figures on the fore-ground, for that hinders their coming forwards, and breaks in intirely on the intention of the painter.

SECTION VII.

General maxims of engraving with the graver.

TO preſerve the equality and union in engraved works, they ſhould be ſketched into great parts before the finiſhing of them be undertaken; for example, of one, two, or three figures, if the ſubject be hiſtory, and theſe figures be grouped; after this ſketch is made, the deſign ſhould be ſo far completed that every thing may be perfectly made out, except with reſpect to the force, in the ſame manner as if it was intended to remain in that condition; becauſe, whoever waits to make the deſign in finiſhing will very often find themſelves deceived. This will even happen to ſuch a degree that there will be no remedy without effacing part of the work, which many perſons will not be willing to conſent to, for fear of ſpoiling that neatneſs of the graver they

they have ſhewn, and on which they have beſtowed all their care, believing all the art of an engraver to conſiſt in ſuch neatneſs; whence we have ſo many prints where the copper is well cut, but where, at the ſame time, none of the talents of an artiſt are diſplayed.

If any infer, from what is here ſaid, that it is uſeleſs to engrave well, they fall into another error; for it is neceſſary to poſſeſs that talent, in order to join, with the juſtneſs and correctneſs of deſign, the beauty of the work, though not to give them up intirely for this, and to place the capital merit in thoſe lickings over, which often render the work black, foul, and ſpiritleſs.

It is not meant, nevertheleſs, that the work ſhould be made grey; on the contrary, it is much better that it ſhould have ſtrength. But the force of a print does not conſiſt ſo much in blackneſs, as in the degradation of the lights to browns, which ought to be made in a more or leſs lively manner, according to the diſtance or nearneſs of the objects to the eye; and even if the works of the great maſters be examined, it will be found that they are not black, or at leaſt have only become ſo with time. They have effectually imitated nature, who is not ſo; eſpecially in the fleſh, and therefore have avoided this, unleſs, when they have repreſented ſome night ſcene, illuminated only by the light of a candle or lamp.

Works in ſmall demand to be engraved with narrower ſtrokes than larger, and with gravers formed a little in the lozange manner; but the ſtrokes ſhould not, however, be too dry and lean, though the figures be ſmall. If the piece require to be extremely high finiſhed, it ſhould not, nevertheleſs, appear overloaded and murdered with work; but, on the contrary, it ſhould be touched with art, in ſuch manner that it may ſeem to be done with expedition and eaſe, although laboured, in reality, with the utmoſt attention.

CHAP. IV.

Of etching or engraving with *aqua fortis.*

SECT. I. *General nature of etching.*

ETCHING (as was mentioned before) is engraving by corroſion, produced by the means of *aqua fortis*, inſtead of cutting with a graver or tool.

The manner (in a general view) by which this is performed, is the covering the ſurface of the plate with a proper varniſh or ground, as it is called, which is capable of reſiſting *aqua fortis*, and then ſcoring or ſcratching

away,

away, by inſtruments reſembling needles, the parts of this varniſh or ground, in the places where the ſtrokes or hatches of the engraving are intended to be. Then, the plate being covered with *aqua fortis*, the parts that are laid naked and expoſed by removing the ground or varniſh, are corroded or eaten away by it, while the reſt, being ſecured and defended, remain untouched.

There are two methods of etching, (as was intimated above) the difference of which from each other conſiſts as well in the difference of the varniſh or ground, as in that of the *aqua fortis* adapted to each kind; but the general method of performing them is alike in both. Theſe varniſhes, or grounds, are diſtinguiſhed by the names of *hard* and *ſoft*; for, in their conſiſtence, or the reſiſtance they give to the needles, lies their eſſential variation from each other. The hard varniſh (as I have good reaſons to conjecture) was not the firſt in uſe, but ſoon took place of the other, and was, for ſome time, the moſt received in practice, on the account above-mentioned, of its admitting the work to be made more like that of the graver. The ſoft has, however, ſince, in its turn, prevailed to the excluſion of the hard in ſome degree, except in the caſe of particular ſubjects; but not ſo intirely, nevertheleſs, as to take away the expedience of ſhewing how it is performed. The method of etching with the ſoft varniſh, is now, however, one of the moſt

moſt important objects of the art of engraving, as it is at preſent in univerſal uſe, ſometimes alone, but more frequently intermixt with the work of the tool, and, in ſome caſes, with great advantage, even where the whole is intended to paſs for being performed by the graver.

SECTION II.

Of the inſtruments employed in etching.

THE inſtruments employed in etching are needles, ſtifts, oil-ſtones, burniſhers, ſcrapers, bruſh, pencils, and a frame and trough.

The needles uſed for etching are of the ſame kind with thoſe uſed for common purpoſes; but ſuch ſhould be choſen, of various ſizes, as will bend without breaking, and are of the beſt ſteel, which muſt be diſtinguiſhed by the grain. They ſhould be mounted on ſticks, the wood of which is firm and tough, ſo as to bear their being driven into it without ſplitting. The length of the ſticks may be about ſix inches, and the thickneſs about three times that of a gooſe-quill, or more. The needles ſhould be fixed in theſe ſticks, in ſuch manner that ſomewhat more than half an inch may be bare, and the reſt buried in the ſticks, and they may be put at both ends; or, in the place of one, a pencil may be fixed. There are two kinds of theſe needles uſed, the

the one called by the French *pointes*, and the other *echoppes*; but with us they are diſtinguiſhed only by the name of round pointed and oval pointed. By which latter it is to be underſtood, ſuch as have one ſide of the round taken off to the middle of the point or centre. Though common needles may be, and moſt frequently are, uſed for this purpoſe, yet it is better to have ſmall rods made by the ſmiths, in the manner above directed for the gravers, and to convert them into needles, at leaſt this becomes unavoidably neceſſary where larger ſubjects are to be engraved. All the kinds are ſold ready made at ſome ironmongers, with turned handles mounted with long knobs of copper filled with hard wax, into which the needles are ſtuck while it is hot, in order that, when by wearing they are become ſhort, the wax being again heated, they may be lengthened at pleaſure by drawing them further out. They ſhould be choſen of three or four ſizes, gradually increaſing to that of thoſe deſigned for the oval pointed, which ſhould be the biggeſt.

Having a proper quantity of needles of different ſizes thus mounted, the ſmaller orders of thoſe deſigned to be round pointed muſt be whetted on the oil-ſtone, in ſuch way as if intended for ſewing; but the larger of this kind muſt be rounder towards the point; that is, with a leſs gradual ſlope from the body of the needle. It is proper alſo to whet ſome with a flat point, or in the manner of a chizzle;

though it is beſt, nevertheleſs, in whetting all the kinds, to give them a long point alike at firſt, and to make them rounder, or give the other proper form, by whetting away the redundant parts afterwards; for they may be eaſily made longer or ſhorter, according to the obliquity by which the handle is held in whetting them. By this way they will all take a little upon the copper, and will not hinder, by their largeneſs, the place where they are put from being ſeen in the uſing them, which is of the greateſt conſequence, eſpecially in working in ſmall. As it is difficult to make a point perfectly round, a method has been invented to render it more eaſy, by forming, in the bottom of the whetſtone, a ſmall channel, in which the needles are to be worked backwards and forwards, turning the handle in the fingers at the ſame time. But by whatever method the whetting may be performed, it is always neceſſary to have the ſlope forming the point, whether it be made upon a greater or leſs angle, exactly even on every ſide, that the point may paſs eaſily and freely on the copper or varniſh in whatever direction it may be guided. In forming the oval-pointed needles there is nothing more required than, after having given a blunt round point to them, to hold the handle with a proper degree of obliquity, and to work the needle on the whetſtone till one ſide be worn down to the centre, obſerving to keep ſteadily the ſame part towards the ſtone; which, when ſome

ſome flatneſs is gained, will not be very difficult.

There is another kind of needle neceſſary, which is called a ſtift, and is uſed for calking and overtracing the deſign on the varniſh. It muſt be formed of one of the ſmalleſt round pointed needles, by blunting and poliſhing the point, that it may glide freely every way over the paper, without ſcratching or cutting it.

The ſcrapers and burniſhers may be the ſame as were directed before.

The oil-ſtones are too commonly known, to need any deſcription. It is only neceſſary to obſerve, with regard to them, that they ought to be ſo ſoft as not to take too faſt on the needles, but to give a keen ſmooth edge, which will not be the caſe, if the ſtone be coarſe and wear the needles too faſt, beſides the inconvenience of producing beards at the points, which are extremely prejudicial in engraving on the varniſh.

A bruſh pencil is likewiſe neceſſary for cleaning the ſurface of the varniſh after the graving, and for other purpoſes. But there is nothing peculiar required in the form, and therefore ſuch as are every where to be had may be uſed.

A frame of boards muſt be provided for ſupporting the plate, while the *aqua fortis* is poured over it, and a trough for receiving the *aqua fortis* as it runs from the board or frame on which it is put; as alſo an earthen pan to collect it as it falls from the trough. The

board, or frame, ſhould be conſiderably bigger than the plates it is intended to bear, and have a ledge or riſing on it at the upper end, and two ſides, as alſo two wooden pegs fixt near the bottom, to ſupport the plate in its proper place, when the board is in an oblique poſition. The trough ſhould be longer than the board, and about four inches deep, and ſix wide, with a ſinking in the middle of the bottom, and a hole through the whole ſubſtance, that it may diſcharge the *aqua fortis* as quickly as poſſible. This board and trough ſhould both be well covered with pitch, or, what is more convenient, painted over with ſeveral ſtrong coats of fat oil and red oker. There is no particular form neceſſary for the earthen pot; it is ſufficient that it be capable of receiving and containing the *aqua fortis* as it runs through the hole in the trough. A veſſel of the green glaſs, faſhioned like a mortar, is better, however, for this purpoſe, where the refiners, or ſtrong *aqua fortis* is uſed, than any veſſel of earth; and it is convenient to have another of the ſame matter for containing the *aqua fortis*, when it is to be poured on the plate, with a cylindrical glaſs, like thoſe uſed for drinking, with a long handle for pouring on the *aqua fortis*. The uſe of this board and trough is principally for the hard varniſh, where the *aqua fortis* is of a much weaker kind. For, in the caſe of the ſoft varniſh, the glaſs veſſel, without the trough, may be made to anſwer the purpoſe better, by

by the method we ſhall have occaſion to explain below.

SECTION III.

Of the compoſition and preparation of the ſoft varniſh.

Preparation of the ſoft varniſh, according to Le Boſſe.

"TAKE of virgin's wax very white "and clean, and of grains of maſtic "very clear and pure, each one ounce, and "of calcined aſphaltum half an ounce. Grind "the maſtic and aſphaltum, ſeparately, very "ſmall, and melt the wax over the fire in "an earthen pot well glazed. When the "wax is thoroughly melted, and very hot, "ſprinkle into it the maſtic gradually, that "it may melt alſo, ſtirring the mixture from "time to time with a little ſtick, in order "that the ingredients may be duly incorpo-"rated. Afterwards ſprinkle the aſphaltum "into the mixture, as was before done by "the maſtic into the wax, ſtirring the whole "compoſition well together, over the fire, "till the aſphaltum be entirely melted and "commixt with the other ingredients; for "which about half a quarter of an hour may

" be allowed. Then take the pot from off
" the fire, and let the mixture cool; and
" having put ſome clean water in a plate,
" pour the varniſh into it, and kneading it
" well in this water, with the hands, form
" it into a roll of about an inch diameter,
" or into little balls, which may be lapt up
" in taffety, to be uſed in the manner below
" directed."

In winter it is proper to increaſe the quantity of wax, otherwiſe the varniſh will be too dry, the proportion above given being calculated for ſummer.

Preparation of the white varniſh of Rhenbrant, to be laid over a thin coat of any of the other kinds.

" Take of virgin's wax one ounce, of ma-
" ſtic half an ounce, of calcined aſphaltum,
" or of amber, half an ounce. Pound the
" maſtic and aſphaltum ſeparately in a mor-
" tar; and, having a new earthen-ware pot
" well glazed, put the wax into it, and
" place it over a fire till the wax be melted;
" then ſprinkle in, by little and little, the
" maſtic and aſphaltum, and ſtir the mixture
" well together, till the whole be incorpo-
" rated. Pour the melted matter afterwards
" into clean water, and form it into a ball,
" which muſt be kept for uſe."

In uſing this varniſh it is proper to take particular care of three things. The firſt, not to heat the plate too much when the

varniſh

varniſh is put upon it. The ſecond, to lay the firſt coat of varniſh as thin as poſſible, in order to be able to ſpread the white varniſh upon it, without rendering the whole of too great a thickneſs. The third, to omit blackening this varniſh with ſmoke, as is done with the common; but when it is become intirely cold, take a piece of white lead, and having ground it extremely fine, temper it with gum water, and then with a pencil lay a coat of it very thinly and equally over the whole plate. This is the manner in which Rhenbrant varniſhed his plates.

Preparation of a ſoft varniſh taken from a manuſcript of Callot.

" Take of virgin's wax four ounces, of " amber, (or of the beſt aſphaltum calcined) " and of maſtic two ounces, of reſin, of " common pitch or ſhoemaker's wax, each one " ounce, and of varniſh, or turpentine, half " an ounce. Having prepared all theſe ingredients, take a new earthen pot, and put " it over the fire, with the virgin's wax in it; " and when that is melted, add gradually to " it the pitch, and afterwards the powders, " ſtirring the mixture each time in proportion to the addition made to it. When " the whole is ſufficiently melted and mixt " together, take the pot from the fire, and " having poured the maſs into an earthen " veſſel full of clean water, form it into balls,

 " by

" by working it with the hands, and keep
" them in a box, free from duſt, for uſe."

The two ounces of maſtic is to be uſed only in ſummer, becauſe it hardens the varniſh, and preſerves it from being crackt by the engraver's leaning over the plate during the graving; but in that deſigned for winter, only one ounce ſhould be put.

Another preparation of the ſoft varniſh, inſerted in Salmon's Polygraphics.

" Take of virgin's wax four ounces, of
" aſphaltum two ounces, of amber, and
" maſtic, each one ounce."

The preparation is much the ſame as for that preceding, only caution ſhould be uſed that the fire be not too ſtrong, as the varniſh will otherwiſe be apt to burn. This varniſh is good only for ſummer uſe, and would be too hard for winter.

Preparation of an excellent ſoft varniſh, of which many of the engravers at Paris make uſe at preſent.

" Take of virgin's wax, and of aſphaltum,
" or Greek pitch, each one ounce; of black
" pitch half an ounce, and of Burgundy pitch
" a quarter of an ounce. The aſphaltum
" muſt be pounded in a mortar, and the wax
" melted over a ſlow fire, in a pot of glazed
" earthen-ware; and the reſt of the ingredi-

" ents added little by little, ſtirring the mix-
" ture accordingly, till the whole be well
" melted and incorporated, and taking care
" that the matter be not ſuffered to burn.
" Afterwards, throw the whole maſs into an
" earthen veſſel full of clean water, and
" knead it with the hands, to form it into
" little balls; and then roll them up in new
" ſtrong taffety, to be uſed as will be below
" directed."

Preparation of a ſoft varniſh according to M. T.

" Take of virgin's wax two ounces and a
" half, of Burgundy pitch three ounces, of
" reſin half an ounce, of aſphaltum two
" ounces, and of turpentine one penny-
" worth."

This varniſh is very good, and well approved. The preparation is the ſame as that of thoſe already given.

Preparation of another ſoft varniſh.

" Take of virgin's wax and aſphaltum
" calcined two ounces, and of black pitch,
" and Burgundy pitch, each half an ounce.
" For ſummer half an ounce of white or
" brown reſin may be added; but in winter
" there is no occaſion for any. The wax and
" pitch muſt be melted in an earthen pot
" well glazed, and afterwards the aſphaltum,
" pounded, muſt be added gradually; con-

" tinually ſtirring the mixture till the whole
" be well incorporated together. The maſs
" muſt be then caſt into clean warm water,
" and kneaded with the hands, to mix it the
" better; care being taken that the hands
" be not ſweaty, for that would ſpoil the
" varniſh.

" It is proper to obſerve that the Bur-
" gundy pitch be very clean, and to be very
" briſk in ſtirring the ingredients when the
" aſphaltum is put to them. After the in-
" gredients have continued melted on the
" fire, for a quarter of an hour, the white
" reſin muſt be put in, and ſtirred, as the
" other, with a ſtick. To examine if the
" varniſh be enough boiled, the ſtick muſt
" be drawn out, and obſervation muſt be
" made whether it rope or not. Then it
" ſhould be ſuffered to cool a little, and af-
" terwards thrown into warm water, that it
" may be worked into balls by the hand, as
" has been before directed."

Preparation of the ſoft varniſh, according to Mr. Laurence, *an eminent Engliſh engraver at Paris.*

" Take of virgin's wax and aſphaltum each
" two ounces, of black pitch and Burgundy
" pitch each half an ounce. Melt the wax
" and pitch in a new earthen-ware glazed
" pot, and add to them, by degrees, the
" aſphaltum finely powdered. Let the whole
" boil

" boil till ſuch time, as that, taking a drop
" upon a plate, it will break when it is cold,
" on bending it double three or four times
" betwixt the fingers. The varniſh being
" then enough boiled, muſt be taken off the
" fire, and having been ſuffered to cool a
" little, muſt be poured into warm water, that
" it may work the more eaſily with the hands,
" ſo as to be formed into balls, which muſt
" be lapt up in taffety for uſe."

It muſt be obſerved, firſt, that the fire be not too violent, for fear of burning the ingredients; a ſlight ſimmering will be ſufficient; 2dly, that while the aſphaltum is putting in, and even after it is mixt with them, the ingredients ſhould be ſtirred continually with a ſpatula; and, 3dly, that the water, into which this compoſition is thrown, ſhould be nearly of the ſame degree of warmth with it, to prevent a kind of cracking that happens when the water is too cold.

The varniſh ought always to be harder in ſummer than in winter, and it will become ſo, if it be ſuffered to boil longer, or if a greater proportion of the aſphaltum or brown reſin be uſed. The experiment above-mentioned, of the drop ſuffered to cool, will determine the degree of hardneſs or ſoftneſs, that may be ſuitable to the ſeaſon when it is to be uſed.

SECT.

SECTION IV.

Of the composition and preparation of the hard varnish.

Preparation of the hard varnish, according to Le Bosse.

" TAKE of Greek pitch, or, in default " of it, Burgundy pitch, and of resin, " or colphony of Tyre, or, in default of it, " common resin, each two ounces. Melt " them together, upon a moderate fire, in " a new earthen pot well glazed; and, these " ingredients being thoroughly mixt, put to " them eight ounces of good nut, or linseed " oil, and incorporate the whole well together, " over the fire, for a full half hour. Con- " tinue afterwards to boil the mixture till " such time as, having taken a little of " it out, and suffered it to cool, it rope in " touching it with the finger, like a very " thick syrup. Take the pot then from the " fire, and the varnish being a little cooled, " pass it through a new linen cloth into " some vessel of stone-ware, or of earthen- " ware well varnished; and afterwards stop " it up in a bottle, or any other vessel that " will not soak it up, and can be well corked. " Varnish made in this manner may be kept

" for

" for twenty years, and will indeed be the " better for age."

Mr. Le Boſſe obſerves that Callot ſent for his varniſh ready made from Italy, and that it was prepared there by ſome joiners, who made uſe of it for varniſhing their wood, under the name of *Vernice groſſo da Lignaioly*, and that he gave him ſome of it, which he uſed a long time; but that when he wrote he employed the kind above deſcribed. The beſt is made at Venice and Florence, where it is ſold by the grocers and druggiſts.

The varniſh, of which the preparation is above taken from Mr. Le Boſſe, is ſubject to many inconveniencies; that of Callot, juſt mentioned, is much better, and more eaſy to be uſed. The manner in which it is made at Florence is as follows.

Preparation of the hard varniſh uſed by Callot, commonly called the Florence varniſh.

" Take four ounces of fat oil very clear, " and made of good linſeed oil, like that uſed " by painters. Heat it in a new pot of glazed " earthen-ware, and afterwards put to it four " ounces of grains of maſtic well powdered, " and ſtir the mixture briſkly till the whole " be well melted together. Then paſs the " whole maſs through a piece of fine linen, " into a glaſs bottle, with a long neck, that " can be ſtopt very ſecurely, and keep it for " the uſe that will be below explained."

SECT.

SECTION V.

Method of applying the ſoft varniſh to the plate, and of blackening it.

THE plate being well poliſhed and burniſhed, according to the directions given p. 49, as alſo cleanſed from all greaſineſs by chalk or Spaniſh white, put it upon a chafing-diſh, in which there is a moderate fire, obſerving to hold it ſo that it may not burn; to do which more commodiouſly, a prop is uſed, and ſometimes two, or even four, as we ſhall ſee below. Theſe props ſhould be fixed to the edge of the plate, in ſome place where there is no engraving; and the plate being thus ſupported, muſt be left over the fire till it be ſo hot that the varniſh, being brought in contact with it, may melt and run through the taffety which is wrapt round it. Then take ſome of the ſoft varniſh well wrapt up in taffety, that is free from all greaſe and dirt, as alſo ſtrong and ſound in every part; for, indeed, it ought to be new, that there may be no weak or worn place in it, where the varniſh may run through in too great plenty. With the varniſh, thus incloſed in the taffety, rub the plate, fixt as before deſcribed over the fire till it grow hot. In doing this, it ſhould be gently paſſed from one ſide to the other in a right line, ſo as to form ſeveral

ſeveral rows, till ſuch time as the plate be every where moderatly covered. After this, with a ſort of ball made of cotton tied up in taffety, beat every part of the plate gently, while the varniſh be yet in a fluid ſtate; and to unite it ſtill more, and give it a finer grain, it is proper to take the plate from the fire immediately, and continue ſtriking it on every part with the ball till it attain a harder conſiſtence in cooling. This muſt not, nevertheleſs, be prolonged till the varniſh be too cold, for then the ball would be apt to make it riſe from the plate.

When the plate is thus uniformly and thinly covered with the varniſh, it muſt be blackened by a piece of flambeau, or of a large wax candle, which affords a copious ſmoke; and ſometimes two, or even four, ſuch candles are uſed together for the ſake of diſpatch, that the varniſh may not grow cold, if that were poſſible, during the operation. The plate muſt then be heated again, in order to the varniſh's being blackened, that it may be in a melted ſtate when that operation is performed; but great care muſt be taken not to burn it, which, when it happens, may be eaſily perceived by the varniſh ſmoking and running into little lumps, as if it had contracted ſome foulneſs. The following expedient is made uſe of, for the more commodiouſly blackening the varniſh, being particularly neceſſary where the plates are large. Fix a ſtrong hook in the beams of the boards of

of the roofing of the room, through which paſs four pieces of cord of equal length, at the end of which are fixt four iron rings of about four inches diameter. The four props, which hold the corners of the plate, muſt be faſtened to theſe rings, and the plate, being thus ſuſpended in the air, with the varniſhed ſide downwards, may be blackened with great convenience. But this is not, however, abſolutely requiſite, except in the caſe of large plates, that could not, without difficulty, be held up, unleſs this, or ſome other ſuch contrivance, were made uſe of.

It is proper to be very cautious in keeping the flambeau or candle at a due diſtance from the plate, for fear the wick may touch the varniſh, which would both ſully and mark it. If it appear that the black have not penetrated the varniſh, the plate muſt be again placed, for ſome little time, over the chafing-diſh; and it will be found, that in proportion as the plate grows hot, the varniſh will melt and incorporate with the black, which lay above it, in ſuch manner that the whole will be equally pervaded by it.

Above all things, the greateſt caution ſhould be uſed in this operation to keep all the time a moderate fire, and to move frequently the plate, and change the place of all the parts of it, that the varniſh may be alike melted every where, and be kept from burning. Care muſt alſo be taken, that during this time, and even till the varniſh be intirely

cold,

cold, no filth, ſparks, or duſt fly on it, for they would then ſtick faſt and ſpoil the work.

SECTION VI.

Method of applying the hard varniſh on the plate, and of blackening and drying it.

THE plate being perfectly cleanſed, and freed from greaſineſs, by the means before directed, it muſt be put on a chafing-diſh, containing a ſmall fire; and when it is become moderately hot, it muſt be taken off again, in order to receive the varniſh, which muſt be thus laid on. Take a proper quantity of the varniſh, and putting it on the end of the finger with a ſtick, or other ſmall inſtrument, touch the plate with it gently, in order that it may be ſpread in ſmall ſpots of the ſame ſize, at as equal diſtances as poſſible over every part; and if the plate cool too much before the whole be finiſhed, heat it again as at firſt, carefully preſerving it, nevertheleſs, from any duſt or foulneſs whatever that may be liable to fall upon it. When this is done, having made the fleſhy part of the hand, below the little finger, thoroughly clean, beat gently with it on the plate, till all the ſpots of the varniſh are driven together, and cover equally

equally and uniformly the whole extent of the polisht surface.

After this beating the varnish, the same part of the palm must be passed over it, in a sliding direction, as if to clean it, in order to lay the varnish yet more smoothly and equally. But the greatest caution must be observed with regard to two points. The one is, that the varnish lie very thin on the plate; the other is, that there be no sweat on the hand, because the moisture would stick to the varnish, and when it is to undergo the effect of the fire, would make, in boiling, little holes in it, that are almost invisible; and which, without great care, when the *aqua fortis* comes to exercise its force on the work that has been engraved, would, at the same time, exert its power on the copper, in these little holes.

The above are the directions given by Mr. Le Bosse for performing this operation. But spreading the varnish on the plate with the hand is subject to great inconveniences, as he himself has remarked in more than one particular. First, in that of burning the hands, which is scarcely possible to be avoided. Secondly, in producing little imperceptible holes in the varnish, which suffer the *aqua fortis* to reach the plate in wrong places, and eat spots in many places of the copper. To avoid these accidents, it is better, therefore, to spread the varnish with a little ball, or puff, made of the cotton and taffety, as is done in the case of the soft varnish.

The

The varniſh being then equally ſpread in this manner, the way to blacken it is to take a large candle of good tallow, which is well lighted, and does not emit any ſparks, and to fix the plate over it, with the varniſhed ſurface downwards, ſupporting it by reſting one of the corners againſt a wall, and holding the other in the hand, and obſerving alſo that the fingers do not touch any part of the varniſh The candle, by this means, being kept perpendicularly under it, the flame will riſe againſt the varniſh, and may be ſuffered to approach it as near as poſſible, provided the ſnuff do not touch it, and in this manner it muſt be moved under every part of the varniſh, till ſuch time as the whole ſhall be made ſufficiently black; but the candle ſhould be ſnuffed when there is occaſion, in order that it may afford its ſmoke more copiouſly. This being finiſhed, the varniſh muſt be baked or dried in the manner below directed; but, in the mean-time, it ſhould be placed where it may be ſafely preſerved from all dirt.

This alſo is the direction of Le Boſſe for blackening the hard varniſh, and it is a very expeditious manner, except in two points. The one is, that, inſtead of a tallow candle, it is much better to employ a piece of flambeau, or a candle of unbleached wax, folded into two, or even four parts, and lighted at the end of each, in order to raiſe a more plentiful ſmoke. The other is, that, inſtead of holding the plate in the air with the hand, which is very trouble-

ſome when it is large, and when ſmall occaſions frequently the burning the hand, one or more props ſhould be uſed for the ſupporting it more commodiouſly, and preventing theſe embarraſſments. The method of doing this may be found in the inſtructious already given, p. 92, for the management of the ſoft varniſh, the operation being the ſame in both theſe caſes.

The plate being thus blackened, the next concern is to dry or harden the varniſh; to which end it is proper to have a quantity of burning coals that ſend out no ſparks, or at leaſt as few as poſſible, and to prepare a coal pan of the ſhape of the plate, but bigger every way, to place it over. The operation may be performed in a chimney, by the aſſiſtance of two dogs to ſupport the plate over the pan of coals. But before it is put there, a napkin, or ſome ſuch thing, ſhould be fixed above, to ſpread over it, to prevent any dirt of the chimney from falling afterwards on the plate. It is proper to be particular in the manner of preparing the pan of coals, and drying the varniſh, becauſe it is a matter of conſequence; and it may be thus performed.

In the firſt place, the coals being kindled, and burning in ſuch manner as neither to flame nor emit ſparks, they muſt be placed in a form reſembling the ſhape of the plate, but in a greater compaſs, by four fingerson every ſide, putting the greateſt part of them to the extremities, and leaving but very few in the middle.

The

The fire being thus adapted, the plate muſt be put croſs it on a pair of tongs, or other ſuch utenſil, to reſt by that means on the dogs directly over the middle of the pan. Being left there for the ſpace of betwixt half a quarter and quarter of an hour, allowing moſt time in winter, the varniſh will appear to ſmoke; and when the ſmoke is found to decreaſe, the plate muſt be removed from the fire, and touched at the ſide on the varniſh with a pointed ſtick, or little piece of hard wood. If the varniſh be eaſily raiſed by the touch, in conſequence of its being too ſoft, the plate muſt again be put over the fire, as at firſt. When it has been there a ſmall time, it muſt be touched as before with the ſtick, and if it do not riſe cleanly, but with ſome force, the plate muſt that inſtant be taken from the fire, and left to grow cold. But if, on the firſt trial, the varniſh reſiſt very ſtrongly to the ſtick, water muſt be immediately thrown on the back of the plate, to cool it as quickly as poſſible, leſt a longer continuance of the heat render it too hard, and burn it. It ſhould be remembered moſt particularly, while the plate is over the fire, to prevent all aſhes, or any kind of dirt, from getting to it; for, otherwiſe, they would ſtick ſo faſt to it that they could not any way be taken off; but after the hardening is finiſhed, no miſchief of this kind is to be much feared, ſince if by accident the varniſh contract any foulneſs, it may eaſily be wiped off with any thing ſoft.

When the varniſh is thus heated, and proves to have grey or rough ſpots, they may be made black and ſmooth as the reſt, by rubbing them with the end of the finger, and a little tallow, or the mixture below directed, and afterwards heating them gently, and then preſſing hard upon them with the palm of the hand in every direction.

SECTION VII.

Method of making the varniſh white, where that colour may be preferred to black.

THE method of whitening the ſoft varniſh is thus. Take white lead well ground in water, and put it into a glazed earthen diſh with a little good glue diſſolved. Put the diſh over the fire, and melt and heat the whole together. After which take this white, which ought to be moderately clear, and with a great bruſh, or pencil of hog's hair, ſpread it as thinly and equally as poſſible on the varniſh laid on the plate, and ſmoothed as above directed, p. 93. Let the colour then dry, laying the plate, in the mean-time, flat on ſome proper ſupport. If the white appear to take with difficulty on the varniſh, there is nothing more required to remedy this default than

than to put a drop or two of ox-gall into the composition, and to mix them well together with the brush used for spreading the colour.

The same manner may be practised with the hard varnish, only it must be first hardened and dried, the blackening being omitted.

Mr. Cochin observes, that there are some, nevertheless, who assert, that the blackening is advantageous, even where the varnish is to be whitened; because, in the engraving afterwards, the hatches would appear darker, and consequently be more perceptible and distinct to the eye. But to this he answers, first, that the black prevents the white from taking hold of the surface, and that it is not safe to put too much gall, for fear of spoiling the varnish; and secondly, that supposing the white would take hold, it would only appear grey, because of the blackness under it, at least unless it was put on so thick as to spoil the whole.

When the varnish is whitened, powdered black lead is preferable, in the calking or over-tracing, to the red chalk, for rubbing on the back of the drawing, or the paper interposed betwixt the drawing and the varnish.

When that which was intended is engraven on the whitened varnish, it is proper to take off the white before the *aqua fortis* be put on the plate. This may be done by putting a little common water, heated somewhat more than warm, on the plate; and, with a soft and clean spunge, or rather with the fleshy part of the fingers, rubbing upon the white,

that it may be every where moiſtened, and then waſhing off the whole with more water copiouſly uſed, and afterwards drying the plate.

To preſerve the white varniſh from injury during the time of engraving, it is proper to put upon it a piece of cloth or ſerge of very ſoft wool, inſtead of paper, or, what is better, a piece of damaſk linen.

If it be deſired to take off the white before the engraving the plate, it may be done by putting ſome of the refiner's, or ſtrong *aqua fortis*, lowered with water upon it, and ſpreading it over the whole. This readily moiſtening and corroding it, water muſt afterwards be put on it, to cleanſe away the whole, and the plate muſt be dried, and may be uſed as if it had not been at all whitened.

SECTION VIII.

Method of calking and retracing the deſign on the varniſh of either kind.

MR. Le Boſſe mentions two methods of calking on the varniſh; the one, by drawing the deſign upon it by red chalk. But, as he obſerves it is very difficult to find ſuch as is very ſoft and fat, and will not ſcore or ſcratch the varniſh, he gives it up, except in

in overtracing, for repairing any thing imperfect, or ſupplying any thing omitted after the calking by ſome other manner. He therefore recommends the other method, which is this. Draw very correctly with a crayon, pen, or pencil, the deſign upon good paper, and redden it afterwards on the back with good red chalk powdered, by ſpreading it on the paper, and rubbing it with a piece of linen, in ſuch manner that the colour may lie equally on every part. Then having taken off all the powder which is looſe on the paper, paſs the palm of the hand ſeven or eight times over it, that the red chalk may ſtick faſt to the paper, and not daub the varniſh. If in any caſe it be neceſſary to oil the drawing, as it often happens when the deſign is turned to the right hand, and, conſequently, being engraved, would come to the left; or, if otherwiſe, when it ought not, it may not be convenient to ſuffer the deſign to be ſpoilt by putting the red chalk on the back of it; a piece of very thin paper ſhould be procured of the exact ſize of the drawing. This paper ſhould be rubbed with the powdered red chalk inſtead of the back of the drawing; and, being laid on the plate with the red ſide towards the varniſh, the drawing ſhould be put over it, and faſtened to it and the plate, in ſuch manner that none of them can be moved from each other, or vary, with reſpect to the ſituation of their parts, from the manner in which they were at firſt fixt. To do this commodiouſly, the beſt method is to

ſtick them together with ſealing-wax, or ſome other ſuch ſubſtance. The drawing to be engraved being thus laid on and ſecurely faſtened to the plate, the manner of the proceeding, in the calking it, is as follows.

Take a ſtift or calking needle, ſuch as deſcribed p. 81, and paſs over the outline of the figures which compoſe the deſign, bearing ſtrongly and equally upon every part, eſpecially where two papers are in queſtion; for, if the drawing itſelf be reddened on the back, there is not occaſion for the ſame force as when another paper, either oiled or not, is added; but if the drawing be not reddened, and the colour be on another paper, which, together with the drawing, makes two under the ſtift, there is conſequently occaſion for double the force that would be wanting if it was only exerted on the paper of the drawing alone. This being done, it is proper to examine that all the outlines of the drawing, over which the ſtift has been paſſed, be marked, imprinted, or calked on the varniſh of the plate. After which, if the drawing itſelf was reddened on the back, it ſhould be taken off, by lifting it up perpendicularly and ſtraightly from the plate, carefully avoiding its rubbing in the leaſt on the varniſh; and, if the colour be on another paper, the drawing muſt be firſt removed, and then that muſt be lifted off with the ſame care. The varniſh being thus uncovered, the traces of red which are formed upon it muſt be gently ſtruck with the fleſhy

part

part of the palm of the hand; and as this is doing, the palm of the hand ſhould be wiped from time to time with a clean linen cloth, to take off the red that may ſtick to it, and prevent its being carried from one part of the plate to the other. Being thus beaten in every place, it will be found that the outlines, which were red before, will have become whitiſh, and be fixt firmly to the varniſh by this treatment.

A large bruſh pencil of the kind mentioned in ſpeaking of the inſtruments, or, what is better, the feathered part of a large gooſe quill, muſt be then uſed to wipe or ſweep every part of the varniſh, ſo that not the leaſt foulneſs may remain; and to do this the better, it is proper to lay the plate on a deſk, or other ſuch ſloping ſurface.

When a picture or drawing is intended to be engraven on the ſame ſize, and turned the ſame way on the plate, ſo that the print will be turned to the oppoſite or contrary ſide to that of the original, a thin piece of paper varniſhed with the Venetian varniſh, very dry and tranſparent, muſt be fixed to it. Upon this paper, the lines of the original, which will appear through it, muſt be marked with a crayon of red chalk, and afterwards calked upon the varniſh, by reddening the back of this varniſhed paper, or by interpoſing another paper, not oiled, but reddened according to the manner above directed, betwixt the oiled paper and the varniſh.

The

The methods of calking may be practiſed in the ſame manner on both the kinds of varniſh, only it is proper to be cautious, in the caſe of the ſoft varniſh, not to bear too ſtrongly on the *ſtift*, which is, nevertheleſs, very allowable with reſpect to the hard, as it would ſtick the paper to the varniſh and ſpoil it.

The back of the deſign, or of the oiled or other paper, where ſuch is uſed, inſtead of being rubbed over with red chalk, may be coloured with white lead, where the tracing may be more agreeable of a white colour than red.

This is the method of calking, when the print is intended to be turned to the contrary ſide with reſpect to the picture; but more particular directions concerning the manner will be found in the firſt volume of this work, under the article CALKING. When the print is intended to be turned the ſame way with the picture, or drawing, the deſign muſt be counterproved upon the varniſh by the method directed in the next ſection.

When it is deſigned to engrave a deſign leſs than it is in the original, a certain number of ſquares muſt be ſlightly traced with a crayon on the picture, print, or drawing, over the whole ſurface; and the ſame number of ſquares muſt be made likewiſe on the paper, which is to be the ground of the deſigned ſketch, but diminiſhed in the proportion the original is intended to be reduced. Afterwards the

ſketch

ſketch muſt be drawn by the eye, taking care to place every part, found in the original, in the ſquare which anſwers to it in the paper or ground of the ſketch. This is called by artiſts *reduction by the ſquares*; but this and ſeveral other methods of reduction are explicitly deſcribed in the firſt volume of this work, under the article Reduction.

SECTION IX.

Method of counterproving the deſign upon the varniſhed plate, in order that the print may be turned the ſame way with the picture, or original drawing.

After having taken the drawing on the varniſhed paper, in the manner above-mentioned, with very ſoft red chalk, or rather with red ink, made of red chalk tempered with water, a piece of paper muſt be had of the ſame ſize as the drawing, and dipt in water, juſt in the ſame manner as if intended to receive the impreſſion of a print, directions for which are given below. The drawing muſt alſo be ſlightly moiſtened with water; but caution muſt be obſerved to prevent its ſoaking through to the ſide drawn upon,

upon as that would hinder the chalk from giving the counter-proof. The drawing being thus prepared, a copper-plate muſt be taken of at leaſt an equal magnitude, that when the drawing is laid upon it the ſides may not reach beyond it. This plate muſt be put upon the table of a printing-preſs, not forgetting to cover it with a piece of moiſtened paper that will fit it, to hinder its dirtying the drawing which muſt be laid on the plate, with the ſide drawn upon upwards. The drawing muſt then be covered with the white paper, prepared to receive the impreſſion, and ſome leaves of blotting paper, or grey paper, moiſtened alſo, being laid over it, ſeveral of the cloths or blankets, uſed by the printers, (of which there will be occaſion to ſpeak more particularly in treating of the manner of printing copper-plates) muſt be laid ſoftly over the whole, which may then paſs under the preſs. It may even undergo the action of the preſs ſeveral times, to render the counter-proof more ſtrong: which being done, and the drawing uncovered, it muſt be examined how well it has marked the white paper. The paper, while freſh re-calked in this manner, ſhould be put immediately upon the varniſhed copper, without giving it time to dry, and paſſed under the preſs, for it can be no more uſed as a counter-proof; and the preſs ſhould then be well cloſed upon it, by turning it ſlowly and equally, in order that the chalk may the better mark the varniſh. But the plate

plate ſhould only paſs once under the preſs, for fear the ſtrokes ſhould be made double. When this operation is finiſhed, it will be found that there is a counter-proof of the drawing on the plate, turned the ſame way as it was deſigned in the drawing, or the original picture, but with much more ſpirit than can be given by calking with a ſtift.

To place the paper, containing the counter-proof, more exactly on the plate, the drawing ought to be marked at firſt with four lines, ſtrong and eaſy to be re-calked in the middle of the four ſides; which may be done by delineating croſs the drawing two lines, the one lengthways, the other croſsways, that intercept each other at right angles in the centre. The four middles of the four ſides of the varniſhed plate ſhould likewiſe be marked at the ſame time, on the edge of each ſide. A counter-proof of the lines on the drawing being marked, along with the reſt of the deſign, on the white paper, it muſt be prickt at the extremity of them with a pin, in order that, in placing it afterwards on the plate, one may ſee on the back where theſe lines which mark the middles are, and put them exactly oppoſite to thoſe which are marked on the edge of the plate. The counter-proof ſhould be faſtened to the ſides of the plate with a very little wax; becauſe, otherwiſe, being cruſhed under the preſs, it may be ſpread to the places that require to be engraved.

There

There is ſometimes occaſion that the parts of a print ſhould be on the ſame ſides as the picture, or original drawing, as there muſt always be, when any action is to be repreſented that is done with the right-hand, and which would otherwiſe appear in the print to be done with the left, if it was engraven on the plate the ſame way as the original. In ſuch caſe, the counter-proof muſt be immediately made from the ſketch on the plate, without re-calking it firſt on the white paper, as was above directed; and, on this occaſion, the ſketch may be drawn with white lead, which will mark it ſufficiently on the varniſh; but would not do ſo well where paper is in queſtion, nor could not, beſides, admit of giving two impreſſions. By this means the print will be brought to turn the ſame way as the picture; but it is neceſſary then to engrave with a looking-glaſs, as we ſhall explain below.

When the ſketch is to be calked in the ſame manner upon the plate as it is drawn after the picture, and there is no occaſion to make a counter-proof, this muſt be done. It muſt be drawn upon the varniſhed paper, and that ſide of the paper, which is drawn upon, muſt be turned towards the plate; and having put betwixt them a paper, coloured as above with red chalk, the ſketch, thus turned a contrary way, muſt be calked, in order that it may come the right way in the print.

To engrave with a looking-glaſs, when the ſketch is re-calked on the plate, in the direction oppoſed to the original, the picture or drawing muſt be put before the glaſs, and placed betwixt it and the perſon who engraves, in ſuch manner that the back may be towards him, and the front towards the glaſs, and then the deſign will appear turned the ſame way as it is marked on the plate. But this, neverthleſs, is not practiſed, except in engraving ſmall ſubjects; for it becomes inconvenient when any larger picture or drawing comes in queſtion; and it is therefore better in ſuch caſe to uſe a counter-proof.

Whatever method is purſued at firſt in marking the ſketch upon it, the varniſh muſt be always re-melted, to hinder its being effaced. This is done by heating the plate with paper burnt under it, moving it from time to time, that it may not be heated more in one place than another, and that the varniſh may not be burnt. When it appears to be melted in an equal manner every where, the plate muſt be removed, and ſet by to cool in an horizontal poſition.

SECTION X.

Of the general manner of engraving on both kinds of varnifh.

THERE are feveral things to be confidered in engraving, as a variety of lines and hatches are to be made of different magnitudes, fome ftraight, and others curved. It muft be imagined, that to make very fmall lines, very fmall needles muft be ufed; and for the larger, fuch as are bigger, with a larger point, and fo of the others. But it is neceffary to obferve this, that, with a large needle whetted to a fhort point, it is difficult to make a large ftroke, except by three ways. The firft is, by bearing very ftrongly on the needle, the point of which being fhort and thick, it makes itfelf a very large paffage; but if this manner be well confidered, it will be found that the ftroke cannot come out neat and fair; becaufe the round of the point does not cut the varnifh, but thrufts it forwards before it. The fecond manner is, by the making feveral ftrokes extremely near each other, and enlarging them at feveral different times; but this is tedious and difficult. The third confifts in making a ftroke moderately large, and leaving the *aqua fortis* on it a long time; but there is more to be faid

with

with regard to this, as will be ſhewn in its proper place.

The above are the directions of Mr. Le Boſſe; who adds, that, from the experience which every day afforded him, he found that the oval-pointed needles were more proper to make large ſtrokes than the round-pointed; becauſe they cut by their ſide, which the others are not capable of doing. He further proceeds in his inſtructions, thus:

The round-pointed needles for engraving ſhould be whetted very round, in order that they may turn freely on the plate; and, above all, they ſhould have their points very keen, that they may cut the varniſh and copper cleanly on every ſide; and if it be perceived that the needle does not paſs freely every way, it may be taken for granted that it is not whetted round.

If lines or hatches, whether ſtraight or curved, are to be made of the ſame thickneſs from one end to the other, common ſenſe dictates that it is requiſite to bear equally on the needle in traverſing the whole length of the ſtroke.

If ſtrokes are to be made that decreaſe during their whole length, it is eaſily conceived, that the method of doing it is to bear more ſtrongly on the needle at firſt, and to diminiſh the force gradually in advancing to the further part, lightening the hand continually, and gradually, from one end to the other, according to the inequality of the thickneſs deſired.

If it be required to make ſtrokes that are thickeſt in the middle, and grow gradually ſmaller towards the extremities, it muſt be done by bearing lightly on the needle at firſt, but increaſing the force till the middle of the ſtroke be formed; and then lightening the hand in proceeding towards the other end, in the ſame proportion as the force was augmented in paſſing from the oppoſite end to the middle.

What has been here ſaid of the three ſorts of ſtrokes, which make ſix ſorts of lines, ſuffices for all the forms of hatches that can occur in ſhading any deſign whatever.

If it be deſired that the work ſhould reſemble that done by the graver or tool, the needle muſt be very ſtrongly borne upon, where it is required that the hatches ſhould be broad, and very gently in the places where they ought to be narrow; for, it is very evident, that when the work is made on the varniſhed copper, and the *aqua fortis* applied, it will hollow out more readily, and powerfully, the ſtrokes or hatches where the needle has been borne upon with greater force, than in the other places where nothing more has been done, than, as it were, removing the varniſh. But then there muſt be ſome other aid given, as will be ſhewn hereafter, in ſpeaking of the hollowing effect of the *aqua fortis*; and by this the work may be executed according to the full intention.

If, after engraving with a ſmall needle, it be required to enlarge the ſtroke more, it is neceſſary to go over it again with another needle that muſt be ſhort and thick, according to the largeneſs of which the ſtroke is wanted, and to ſink deep with it the thickeſt places of the hatches. This is to be done in the caſe of the round-pointed needles; but more principally in that of the oval-pointed; and by proceeding in ſuch manner, the plates will afford many impreſſions.

It remains to treat of the manner of taking aſſiſtance from the uſe of the *echoppes*, or needles whetted to an oval point. The avail when it is deſired to enlarge, or render thicker, any hatches or ſtrokes, or where hatches or ſtrokes are required to be of ſuch thickneſs, that the laying aſide the round-pointed needle is unavoidable. This ſhould never be done, however, but where there is found an abſolute occaſion, as the round-pointed enter much more keenly into the copper than the oval-pointed. The exceſſive thickneſs of the ſtrokes, which is requiſite to be made on certain occaſions, often creates, nevertheleſs, the neceſſity of having recourſe to oval-pointed needles; in which caſe, all that is to be done, as I have ſaid before, conſiſts in this; that having made the thick ſtrokes with the oval-pointed needles, they muſt be ſtrongly retouched with one of the largeſt of the others, whetted to a ſhort and round point in the middle; and this is to be

 done

done principally in the places where they are the broadeſt.

The manner of holding the oval-pointed needle is the ſame as that of holding a pen, except that the face or cut part of the pen is turned towards the palm of the hand, and that of the oval-pointed needle generally towards the thumb. This is not, however, becauſe it is impracticable to turn or manage it in any other direction, for the oval or flat part may be turned towards the middle finger; but becauſe it is the moſt convenient method of handling the inſtrument, and affords alſo the means of uſing great force with ſteadineſs.

There are ſome engravers, who, having made narrow ſtrokes with round-pointed needles, re-touch them again with the oval-pointed, in order to make them broader in the neceſſary places. But it is better to make them firſt with the oval-pointed, and then to re-touch them with the round-pointed; becauſe the latter enters better into the hollow traces left by the firſt than they in thoſe made by the latter; and the lines which are made this way are much more cleanly cut.

Thoſe who are capable of uſing the graver, may enlarge the hatches with it, after the *aqua fortis* has had its effect on the work, better than by the method juſt mentioned, and the ſtrokes will be much fairer. It is proper to add, that, in engraving on the varniſh, the needles

needles, both round and oval-pointed, ſhould be held as perpendicularly, or ſtraight on the plate as is poſſible. The habit alſo ſhould be acquired of moving them briſkly, that the hatches may be more clean and ſteady; and, on this account, the inſtruments ſhould never be uſed but when they are well ſharpened, and in the beſt order, to keep them in which, they ſhould be often whetted.

It may be likewiſe well to ſubjoin, that the ſoftenings which are given to the lights in any deſign, as alſo all the diſtant objects, ought to be worked with very ſmall needles, and a gentle force on them; but the lines ſhould be ſtrongly ſunk in the places that ought to be more ſtriking to the eye, as the ſhades, to the end that a great part of the ſoftenings and diſtances may be covered, after having been corroded a ſhort time by the *aqua fortis*, in the manner below directed; for it is obvious that the needles, which have made the hatches near the lights, have had very little effect on the copper; ſo little, indeed, as ſcarcely to take off the varniſh; for which reaſon, in applying the *aqua fortis* to them, it corrodes or hollows leſs ſtrongly by much there than upon the ſtrokes that have been made with more force, in ſuch manner, that having covered, at the ſame time, all the diſtant objects, the places, thus ſtrongly touched, will have more effect than the others. The doing this judiciouſly, makes one of the

principal points of ſkill in the art of engraving with *aqua fortis*.

One thing more may be likewiſe added, that it is neceſſary to be careful to bruſh, or wipe off, with a large pencil, or, in default of ſuch, the feathered part of a quill, all the ſmall parts of the varniſh or copper which the needles have cut off in the graving, that they may not ſtick in the hatches, for that would cauſe ſcratches to be made upon the varniſh, in moving the paper, which is put to preſerve it in leaning upon it.

The manner of engraving on the ſoft varniſh is much the ſame with that of the hard, except that it muſt be done more delicately, and with greater precaution, to prevent damaging the face, on account of the ſoftneſs of the ſubſtance, which makes it more ſuſceptible of injury, from ſlight violence. The needles alſo may be the ſame in both kinds of varniſh, though ſome painters reject the oval-pointed in the caſe of the ſoft, notwithſtanding they are very uſeful, eſpecially in engraving architecture. But this muſt be left to the choice of each artiſt, as it may ſuit his own particular manner of working. The uſe of the oval-pointed needle is indeed good for engraving every thing that admits of a coarſer manner, as ground, trunks of trees, walls, &c. which demand ſtrength with nibbled work, as we ſhall ſee hereafter. It may be remarked here, that though this inſtrument ſeems fit for making large ſtrokes, it may neverthleſs be uſed alſo for making the moſt

moſt fine and ſmall, by holding it on the ſtraiteſt ſide; and if any perſon be well practiſed in the uſe of the oval-pointed needle, they may completely etch a whole plate, without any other inſtrument, by furrowing it, more or leſs, according to the largeneſs of the ſtrokes they would make.

The greateſt care ought, as has been juſt before intimated, to be taken, in preſerving the ſoft varniſh on the plate; for it is very liable to be ſcratched or bruiſed in the engraving, by the rubbing or touching with any hard body. There are ſeveral methods, however, of ſecuring it; of which, one is to have a kind of deſk, where the plate may be put; and fixing a frame, or rail, on the deſk, on each ſide of the plate, to lay narrow boards croſs them; on which the perſon engraving may lean without touching the part of the plate which is betwixt him and that he is working upon.

Another method uſed by ſome is, to work with the plate upon a kind of eaſel, in the manner of the painters, and it is a very good manner; but few perſons can ſoon accuſtom themſelves to it. The moſt eaſy way, is to have a table, in the manner of a deſk, and putting a proper piece of either white or brown paper on it, to lay the plate upon the paper, and with a linen napkin of diaper, or damaſk, uſed till it be ſoft, and folded very even, to cover that part of the varniſh which requires it in the graving. The napkin ſhould

be very ſoft and pliable, and folded into four doubles; and it ſerves extremely well to reſt the hand upon in working, as the leaves of paper in the caſe of the hard varniſh. Inſtead of the linen, a piece of ſheep's ſkin, dreſſed in oil, may be uſed, with the ſoft ſide turned towards the varniſh; and, on leaving off working, all the plate may be covered with this ſkin, to prevent any dirt falling on it, or other accident damaging it. What is moſt to be feared in this method, is the leaning too ſtrongly on the napkin or ſkin; becauſe the buttons of the ſleeves of the coat, or of the ſhirt, may eaſily, in bearing on it, hurt or ſpoil the varniſh; for which reaſon, they who work in this way ſhould never have buttons on the under part of their ſleeves, or ſhould at leaſt be very careful about them.

If it happens that, by ſome unlucky accident, the varniſh is ſcratched in any part of the plate, the injury muſt be repaired by taking the Venetian varniſh, commonly called the painters varniſh; and, having tempered it with a little lamp-black, to cover, by means of a ſmall pencil, the ſcratches, flaws, or falſe ſtrokes, with the mixture. This invention, which is of late date, is extremely uſeful, as the plates thus repaired may be equally well graved upon; and the *aqua fortis* will do its office there as effectually and cleanly as in any part of the varniſh; for which reaſon, if any fault is made in the work, by putting hatches where there ought to be none, or turning

turning others the wrong way, they may be covered in either a greater or leſs ſpace by this mixture; and, when it is dry, may be engraved afreſh; and this may be repeated on the ſame part, where neceſſary, without the leaſt inconvenience, for any number of times. The varniſh uſed for this purpoſe ſhould be new, for keeping renders it thick, which prevents its covering ſo evenly what is employed to deface; and, when any place is covered with it, great care ought to be taken not to preſs too ſtrongly on the napkin or ſkin laid over it till ſuch time as it be perfectly dry, not only for fear of bringing it off by its ſticking to them; but alſo, leſt any lint, or wool, may be left by them upon it, which would hinder its being engraved over again in a proper manner.

If the varniſh ſcale in working, that is to ſay, will not ſuffer itſelf to be cut cleanly, but riſes in ſmall flakes, as happens more particularly in winter, it is a proof that it is too hard. In ſuch caſe, the flaws, or part where it has ſcaled, muſt be covered with the Venetian varniſh and lamp-black, as has been above directed; and a gentle fire of hot aſhes muſt be put betwixt the table and the board on which the plate lies to be engraved, to ſoften it by the warmth, and render it more yielding to the needle.

With reſpect to thoſe who work on the ſoft varniſh, with the plate put on an eaſel, they do not run the ſame riſk of having the varniſh bruiſed,

bruiſed, nor have occaſion ſo frequently to wipe the plate; becauſe, being placed obliquely, the little ſcales of varniſh, raiſed in the graving, fall off of themſelves. The eaſel may be the ſame as that uſed by the painters; and the only difference in the whole is, that in one caſe a pencil is uſed, and in the other a needle; except that it is neceſſary, in the caſe of engraving, to have the eaſel ſtrong, and very firmly fixt, that it may not ſhake or give way in bearing ſtrongly againſt the plate, which is neceſſary in a greater degree where large ſtrokes are to be made. It is ſaid that Callot worked in this manner on account of his health, which he ſuppoſed to ſuffer from a more bending poſture; for which notion he had probably great reaſon, as many others may have, in parallel circumſtances.

Notwithſtanding the moſt ancient, and the moſt common manner of engraving, is to uſe needles which cut, and make ſome impreſſion on the copper; yet there are, nevertheleſs, very able gravers who employ needles that do not cut at all; and this practice appears advantageous with reſpect to the effect that the ſtrong *aqua fortis* has upon the varniſhed plate; for it often happens, in tracing an outline, or in ſome touches made with a cutting needle, that the exactneſs with which it is endeavoured to be done, occaſions, without its being perceived, a greater bearing on the needles, ſo as to make it enter more deeply into the copper in theſe places than in any other,

other, which caufes them to be more corroded than the reft, and produces fpots too fharply marked; inftead of which, the blunter-pointed needles, not hollowing the copper more in one place than another, fuffer it to be almoft equally corroded every where, according to the proportion of the needles employed, and confequently produce a grey effect, very advantageous for touching properly on fome occafions.

On the other fide, it may be faid, with refpect to making an impreffion on the copper, that it gives more fpirit and firmnefs, than when the needle only glides over the furface, and has no hold of any thing; for which reafon it is expedient, where a plate is prepared for great defigns, and the graver is to have a confiderable fhare of the work, to make ufe of blunt needles, and to confine thofe with cutting points to engravings in fmall, which ought to be prepared differently, as we fhall fee below. It is to be remarked, with regard to the needles which cut, that they fhould be borne hard upon in making the hatches that form the maffes of fhade, without which they become lean; for, in proportion as the ftroke is intended to participate of the largenefs of the needle with which it is made, almoft all the fharpened part of the needle muft be introduced into the fubftance of the copper, otherwife, a large needle and a fmall one would make ftrokes of nearly the fame breadth; but however large the hatches may be made, it is proper,

proper, neverthelefs, to put many of the feconds, below fpoken of, into the fhades before the firft corrofion, that the *aqua fortis* may give all the poffible affiftance to the force of the effect; which, after long corrofion, would be flight from one ftroke only.

SECTION XI.

Principles refpecting the manner of engraving, with the methods applicable to particular fubjects.

THE plate being prepared and calked, the terminations of the fhades and demi-teints fhould next be marked out. But the artift himfelf fhould calk the defign, and never truft it to others, in order to have it as correct as poffible; for though errors might be amended in the engraving, yet it is better to be certain of a true guide than to grope out the way, efpecially as unavoidable faults enough will be committed, after the moft affiduous care, without giving room for more, by the neglect of due precaution.

Engraving differs from drawing in this, that in the firft, they begin by preparing the foft fhades, and give afterwards the touches upon them; but that, in the latter they put the touches firft, after which they add the fhades

to

to them. The reaſon is, becauſe they cannot re-enter the ſtrokes in the ſoft varniſh, which has not reſiſtance enough to keep the needle ſteady, and prevent its deviating from the line of the ſtroke already made. It is not neceſſary, however, to draw every where with the ſtift the ſketch of that which is to be engraved; becauſe it may prove, in the progreſs of the work, that parts may be, in that caſe, traced which were not neceſſary. The little parts ſhould therefore be traced, according to the occaſion there may be, to place the ſhades in marking the principal touches; and the ſide of the light ſhould be afterwards drawn with a very fine needle, or even by ſmall dots, or ſtipling, (as the working with ſuch dots is called) if they be in the caſe of fleſh, forming ſtrokes only in the places which ought to be more apparent. Theſe ſtrokes ought alſo to be accompanied, if in the caſe of fleſh, by ſome points or dots; or, if in draperies, with other ſtrokes or hatches, that they may not be lean and hard by ſtanding alone. Engraving is at the beſt but too hard of itſelf, on account of the neceſſity there is to leave white between the ſtrokes; for which reaſon it ſhould always be made an object of purſuit to find out the ſofteſt and richeſt manner poſſible, as it is not practicable to make a thick and full ſtroke, that will not at the ſame time be black, to imitate the ſoftneſs of the pencil or crayon, which make them broad, and yet, at the ſame time, tender, it is neceſſary to make

make uſe of ſeveral very narrow ſtrokes, the one at the ſide of the other, or of points, or ſmall dots, to accompany what is traced with a very narrow line, as a ſhade, that it may be ſweetened by them. The ſame thing muſt be obſerved in the touches of the ſhades, and care muſt be taken, that the lines, in the middle of a touch, be made ſtronger than thoſe at the extremities. The ſhades are engraved laſt by hatches ranged in a regular order.

Engraving being to be conſidered as a manner of painting, or drawing with hatches, the beſt and moſt natural manner of taking the ſtrokes is to imitate the touch of the pencil, if it be a picture that is copied; and there is ſcarcely any picture done in a maſterly way, where the management of the pencil is not diſcoverable. If it be a drawing, the ſame manner of hatching ſhould be followed as if it was copied with a crayon; but this is only with reſpect to the firſt order of ſtrokes; for, with regard to the ſecond, it muſt be gone over in the manner that beſt conſtitutes the form conjointly with the firſt; and, by its aſſiſtance, ſtrengthens the ſhades, and terminates the edges of them, in a manner a little flat, that is to ſay, a little cut and without ſweetening. This muſt not be continued in the reflections when they are tender; but they ſhould be left a little more light than they ought to be when the plate is finiſhed, reſerving to the graver, which ought to complete

plete the work, the buſineſs of lengthening theſe ſtrokes to darken the reflections, and take away from them the tranſparency, which renders them too like to the parts that are in full light. If the ſhade be very ſtrong, and the reflection alſo, it muſt then be engraven with two ſtrokes, by a large needle, and the reflection, in the ſame manner, with two ſtrokes, but by a ſmaller needle.

In the forming the ſtrokes, where there are ſeveral orders, theſe rules ſhould be obſerved.

The firſt ſtroke ſhould be made ſtrong, bold, and cloſe; the ſecond a little finer and more diſtant; and the third yet ſmaller and more free or wandering. This may be either done with the ſame needle, by bearing more or leſs ſtrongly on it, or rather by changing the needle, and uſing ſuch as are of a different thickneſs, if the ſubject that is engraved abound with bright and fine colours. When the double and triple ſtrokes are nearly alike, they produce a dull and heavy colour, which does not attract the eye; and, on the contrary, when they are unequal with reſpect to each other, they make a more pleaſing work, and ſuch as is better adapted, in the parts where the light falls in the linen, in rich ſtuffs, &c. The firſt ſtroke ought not to be ſtiff, it is to give the form; the ſecond is, as it were, to paint; and the third to foul and deſtroy certain things, that the work may not be every where of equal beauty; it ſerves alſo to glaze the ſtrong ſhades, which, without that, might be of too hard a nature;

nature; but it ſhould be uſed with diſcretion. If the firſt and ſecond be ſquare, the third ſtroke ought to be in the lozange poſition, upon one of the others; and, on the contrary, it ſhould be ſquare upon one of the two, if they be in the lozange form, in order that there may be always a ſquare upon one, and a lozange upon the others, which produces a grain that is very ſoft and in good taſte. In engraving with the *aqua fortis*, a third ſtroke ſhould ſeldom or never be made; becauſe ſomething ſhould be left to be done by the graver, that the print may prove of an agreeable colour; beſides, it frequently happens, that the corroding too much renders it blacker than it ſhould be; for theſe reaſons, we will confine our conſideration here to the two firſt.

The ſecond ſtroke ought to be laid on the firſt, more or leſs, in the lozange figure, according to the nature and character of the ſubjects that are engraved. Fleſh, for example, ought to have half lozanges, that the third, coming to finiſh, may have a good effect, which cannot be if it be laid on hatches that are ſquare to each other. The lozange ought not, nevertheleſs, to be carried to exceſs, becauſe the angles where they join become too black, the *aqua fortis* acting more powerfully there than elſewhere. This would produce an engraving too coarſe and foul, by the quantity of third ſtrokes, or of points, which muſt be put into the ſquares to give them an unity of tone. And in engraving with

with *aqua fortis*, the artiſt ſhould never loſe ſight of the manner in which the graver ought to finiſh the work, but ſhould foreſee, from the beginning, the effect that the re-touches will have, which are intended to be introduced.

As to other caſes, the having more or leſs of the lozange depends on the character of the fleſh that makes the ſubject. If it be the fleſh of muſcular men, and who are painted in a bold manner, there is no danger of ſpoiling it by ſtrokes thrown together confuſedly, but a little inclining to the lozange; but, on the contrary, the fleſh of women require a more uniform manner of working, that may expreſs the fineneſs of their ſkin, which a too large lozange would break in upon.

There are, neverthelеſs, very able men who maintain the contrary, and aſſert, that the lozange is leſs to be feared in delicate fleſh than in that which demands a great ſtrength of colouring, having found, when they would puſh the effect with more vigour, that the lozanges become incommodious. However it may be, ſquare hatches ſhould be above all things avoided, not being good for any thing but to repreſent wood and ſtone. It is true, excellent pieces of engraving may be found where the ſquares abound much; but that does not hinder its being a bad manner, and it is certainly not on account of this particular that they excel, for the lozange manner muſt be allowed to be greatly ſofter. The fineſt

examples that can be given, are the prints of Cornelius Vischer, whose taste in engraving is, without exception, the best that can be chosen for imitation.

Draperies ought to be engraven on the same principles as flesh; the strokes should be taken in such manner that they may express well the folds; and to that end it is not proper to be confined to continue a stroke, which has served well to form any thing, when it is no longer fit to delineate that which succeeds. It is much better to break it off there, and to begin another which may be more suitable; observing, nevertheless, that they may serve for seconds one to the other, or at least for thirds. If it happen to be favourable for a second, it may be passed above the other with a very fine needle; if fit only for a third, the office may be left to the graver to lengthen it, and to lose it insensibly among the others.

In short, there must be nothing in this kind of engraving which savours of constraint; this continuation of the same stroke is the custom only in the works done by the graver alone, though even there it is not very necessary; and Bolswert, who excelled so much in that way, never embarrassed himself about the matter. It would, nevertheless, be very injudicious to fall into the directions of strokes diametrically opposite to each other in the same piece of drapery, when the separations caused by the play of the folds were not very distin-

diſtinguiſhable; for this would make a drapery which would appear compoſed of different pieces that had not any connection one with the other. It is this ſame oppoſition of work, joined to the different degrees of colour, that the original picture or drawing dictates, which ſerves to detach two different parts in any drapery, and to explain to the eye that they are not dependant one upon the other; for this reaſon, the different directions of the ſtrokes, which form the folds of the ſame drapery, ought to be made nearly in the ſame manner, provided that can be done without conſtraint, reſerving the liberty of making them in a different direction, when the diſpoſition of the draperies may diſcover the doubling of the ſtuff; for then this difference of the ſtrokes ſerves to diſtinguiſh more clearly the upper or under part of the drapery.

The ſtrokes ought to wind in a ſupple manner, following the play and the depth of the folds. It would be a bad method to form them only with one ſtroke, and then to lay another ſtiff and inflexible one over that, for the ſake only of giving a blacker caſt. It is better, on the contrary, that all the work which is introduced ſhould have its own proper intention, and aſſiſt in conſtituting the figure of what is to be repreſented; at leaſt, there ſhould be only ſome things left in a dubious ſtate, for the preſerving the proper keeping of ſuch others as ought not to attract the eye of the beholder. It ſhould be parti-

cularly avoided not to make the ſtrokes that terminate on the outlines, either of folds or parts of folds, end at right angles with ſuch outlines, nor even in any manner approaching to it; but they ſhould loſe themſelves in a lozange, in ſuch a way as may ſerve to render them leſs perceivable, and give a ſofter effect. With reſpect to the ſtrokes which form the fore-ſhortenings, without knowing a little perſpective, to conceive a right notion of them, there is a great hazard run of frequently taking them the wrong way.

The managing rightly the demi-teints ſhould be a particular object of regard. After having ſteadily fixed the bounds of the ſhades, and in a manner a little cut, an arrangement ſhould be made with a finer needle of the ſtrokes which form the demi-teints; obſerving to put very little work, or at leaſt in very tender manner, in the maſſes of light, that the effect may not be impaired by ſuch work; as, being too black and uſeleſs, it would only foul the parts that require to be kept bright. Theſe ſtrokes ought to be taken in ſuch a manner that they may be connected with one of thoſe of the ſhade; and if it be in the caſe of a demi-teint that is ſtrongly coloured, and which requires two hatches, when the ſecond cannot be joined with any of thoſe of the ſhade; it is, however, proper that it ſhould loſe itſelf there, or ſerve in the place of a third. As to the reſt, it is not neceſſary to take the trouble of joining with the *aqua fortis* ſuch as

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are capable of being conjoined. There is a hazard of not doing it exactly enough, and the ſtrokes not proving to correſpond duly with each other, would make, as it were, a furrow more black than is proper. It is much better to leave that work to the graver, which will unite them, and only, perhaps, render them too round.

One may venture to make ſome fine ſtrokes with the needle near the light; but they muſt be more free, that is to ſay, more ſtraggling from each other than thoſe of the ſhades. In general, the ſtrong lights, and thoſe nearly approaching to them, ſhould be kept from the *aqua fortis*, in order to leave ſomething to be done by the ſoftneſs of the graver.

Linen, and other fine and light ſtuffs, may be prepared with one ſtroke only, that opportunity may be had to give with the graver, by places, a very ſlight and ſmall ſecond.

The points or dots that are made with the *aqua fortis*, to form the demi-teints of fleſh, may be made in different manners, which all have a happy effect when they are diſpoſed with taſte. They are put in the fleſh of men along the ends of, or between the ſtrokes; or in rounds, which may be lengthened afterwards with the graver, though it is better only to intermix them with long ſtrokes at the time of re-touching. In the fleſh of women, only rounds are made with the *aqua fortis*, as the long ones would be of too coarſe

a work; but to prevent their being perfectly round, which would produce a taſteleſs and cold regularity, the needle is held a little obliquely in ſtriking them. When great figures are engraved, a large needle is uſed, which renders the dots or points more full. In all caſes the round points ought to be made with the *aqua fortis*, as it gives them a certain pictureſque coarſeneſs; which, mixt with the neatneſs of the graver, produces a better effect than the ſame round points would have, if made only by ſtipling with a dry needle. It is for this reaſon, that in the fine heads engraven by the graver alone, we ſee only long ſtrokes, the rounds not being beautiful, except when they are formed by the *aqua fortis*. They are arranged ſomething in the manner of bricks in a wall, the middle part being over a joint; and, above all, it is neceſſary to preſerve great regularity; for whether it is that the thickneſs of the varniſh deceives, or whether it be owing to ſome other cauſe, it happens that, in ſpite of all regularity which has been obſerved, when the plate is corroded, they are yet ill enough arranged; and, if care were not taken to remedy it in re-touching with the graver, it would produce a fleſh that would look milky. The points made with the *aqua fortis* ought not to approach too near the lights; room ſhould be left to put in by the graver, or with the dry needle, the moſt minute that can be made; which may be continued

tinued infenfibly even to the white. Long points, or rather very fhort ftrokes with roundifh ends, may be put, likewife, into draperies, when very thick ftuffs are to be depicted; and to give them that picturefque coarfenefs which diftinguifhes them from other ftuffs more even, the hand is fhaken a little in tracing the ftroke, which gives it a waving that fucceeds very well with regard to the effect; but this muft be done without running into affectation. Great care fhould be taken, when any thing great is engraven, not to form the touches in the flefh, either of the head, hands, or elfewhere, with ftrokes fo near one to the other as that the *aqua fortis* may make them run together, and form one of feveral. This would produce a fharp and foul blacknefs, which would require much trouble to be fet to rights; for which reafon the flefh fhould be prepared tenderly, and corroded but very little, in order that it may be finifhed more eafily, and in a foft and pleafing manner.

The degradation of objects is alfo a principal matter of concern in engraving, and it is a rule founded on good fenfe and perfpective, to bring the ftrokes more and more clofe, correfpondently to the effect of fuch degration, with refpect to their diftance. That is to fay, having engraved figures, which are on the fore-ground of the picture, with a large needle, and full ftrokes placed moderately afunder, the figures which are in a fe-

cond ſtage of diſtance, and deeper in the picture, ſhould be engraved with a ſmaller needle, and the ſtrokes brought nearer to each other. If there be a third ſtage, a ſtill finer needle ſhould be employed, and the ſtrokes made yet cloſer; and this ſhould be done even to the horizon, always preſerving this idea of degradation. It is for this reaſon that the more diſtant parts are generally covered with thirds, and ſometimes even with fourths; becauſe that fouls the work, and renders it, conſequently, leſs apparent to the eye; beſides that, taking away the little ſpots of white, which remained betwixt the ſtrokes, cloſes the work more, and makes the objects keep back much better. This manner of engraving produces alſo a grey and dull caſt, of great conſequence to the keeping, which ſuffers the large and full work of the fore-ground to go better off, and gives it its due effect; but it is the office of the graver, rather than the *aqua fortis*, to execute it.

Fore-grounds are likewiſe engraven with ſtrokes of different ſizes, according as the caſe may require. Fine ſtuffs may be engraved cloſer, at leaſt where they are not intended to receive inter-ſtrokes; which, nevertheleſs, are very proper to repreſent ſilks, water, and metals, or other poliſhed bodies. Thicker ſtuffs may be engraved wider; the part which is to be brown and dull, cloſer than that which is to be leſs full of work,

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and consequently the shades than the lights. This distinction ought not, however, to appear too sensibly, for fear something should be seen in the work of the fore-ground which might make it appear not of a piece with that of the black.

The expression of the great distance of objects claims, likewise, a peculiar attention; and it is a leading principle in perspective, that the more objects appear afar off, the less they ought to be finished. Nature is exactly correspondent to this. When we see a distant object, for example, a figure habited, nothing is distinguished but general masses, and all the minuter parts, whether of heads, or folds of vestments, or even the different colours of such vestments, are lost to the sight. Engraving, which is only an imitation of nature, ought to follow her in all her effects, and render the objects it represents more and more formless, in proportion to their distance. For this reason, it is avoided in engraving distant figures to draw the forms with outlines strongly marked, and visible in many places, which would make them too distinct; but they must be traced by large parts, and as a first draught, and the shades by flat grounds, something in the manner by which a sculptor sketches a figure of earth. The famous Gerard Audran has given admirable examples of this in all his works, as may be seen among others in the print of Pyrrhus relieved from danger, which he has

has engraved after Pouſſin, where he has given the broad and flat touch of the pencil, in the diſtant parts and back grounds, in a manner worthy to be admired. This ſeems eaſy enough to be done, and yet it is never found well executed but in the works of thoſe who are conſummately expert in the art. The greateſt difficulty in the arts, is not to finiſh and to work minute things up to the greateſt point of exactneſs, but to know how to ſuppreſs advantageouſly all ſuperfluous work, that nothing may be retained but what is neceſſary. It happens but too often that an engraver, ſeduced by the pleaſure of doing a piece which may appear very carefully executed, amuſes himſelf in finiſhing the head of a diſtant figure with pretty little points, ranged with much neatneſs; but he laviſhes his pains to a very bad purpoſe; for this labour, which if beſtowed elſewhere would have its merit, makes him commit a blunder againſt common ſenſe, and the propriety of the deſign.

SECTION XII.

Of the manner of engraving particular ſubjects.

EARTH, walls, trunks of trees, and landſkips, ought to be engraved in a manner

manner extremely waving; in theſe caſes, the ſquare may be ſucceſsfully mixt with the extreme of the lozange, and the oval-pointed needle made uſe of by the broadeſt ſide, in order that the ſtrokes may accompany more ſoftly the lines which deſign them, and leave the leanneſs of the outlines, which form the leaves, leſs viſible. Earth may be engraved by little ſtrokes, ſhort, and very lozange, that the cracks of their angles may render them coarſe, and formed by all ſorts of free work, which is very ſuitable to them.

Blunt needles are more proper for engraving architecture than thoſe that are more cutting, becauſe theſe laſt entangle themſelves in the copper, and do not leave the hand the freedom of guiding them every way, as it is neceſſary they ſhould, eſpecially in the engraving trees. Architecture is commonly engraved ſquare and regularly. When, nevertheleſs, it is only ſecondary, as in a ſubject of hiſtory, in which caſe it is made ſubſerviently to the figures, it is much better to engrave it with the hand, that it may not have a neatneſs which may rival the figures. The ſtrokes muſt be alſo a little waving, but ever with order; becauſe, in general, things that are engraven, even thoſe which are leaſt capable of neatneſs, ought always to be done with equality and arrangement, provided it may be without affectation, that there may be no lines which may run into each

each other, and break the keeping of the maſſes, by ſpots of too ſtrong black. For effect can be made only by great maſſes united, whether of ſhade or of light, relieved, nevertheleſs, by ſome touches in the places indicated in the original, which ought to be ſtrictly followed. Engraving is at beſt only too repugnant to that keeping which ought to reign in the maſſes, by the little white interſtices that are left in the ſquares, without yet adding thoſe ſtrong ſpots and holes of black, by the irregularity of the ſtrokes; and it is frequently neceſſary even to cloſe up, as it were, all thoſe ſquares with points, to be able to make a dead tone or caſt. It reſults from what we have here laid down, that the engraving in great, where many things are left to be re-touched by the graver, ought to be prepared with much taſte and neatneſs; alſo that it muſt be avoided to uſe too much force in the touches and outlines, for fear, when they come to be corroded with the reſt, there may be a neceſſity of taking off the *aqua fortis* before it has been ſuffered to corrode the ſhade to an advantageous tone; or rather, that the *aqua fortis* having hollowed them too much, it may make it requiſite to foul the work to accompany and correſpond with them, or perhaps even after all, to efface them intirely. It is much better to be obliged to ſtrengthen them with the graver, eſpecially, as whatever pains may be taken to hit

hit the point, it may prove, neverthelefs, when the *aqua fortis* has had its effect, that there will be occafion to re-touch them; and, as moreover, they will never be found to have that perfect exactnefs which it had been hoped to have given them. For this reafon, it is proper that the touches and outlines fhould be corroded in fuch manner that they may be gone over again eafily, either on the infide or outfide, without effacing any thing.

Engraving in fmall fhould be treated differently from engraving in large; as the principal merit of it confifts in being defigned and touched with much fpirit; the fketch fhould be drawn with more force and boldnefs, and the work which is added fhould be done with a freer, and, as it were, more fportive needle. The touches which take away the eafe in defigns in large, are the whole life of thofe in little, in preferving always the maffes of light tender and large. All this excellence depends on the *aqua fortis*, and the graver ought to add to it nothing but ftronger maffes, and fome fweetenings. As the graver is an inftrument that works ftiffly, and with coldnefs, it is very difficult not to diminifh, or even not to deftroy, that fpirit and lightnefs the needle of an engraver well verfed in defign has given to the work; for which reafon it fhould be ufed with great difcretion, and only to give a little more effect and keeping.

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The *aqua fortis*, therefore, muſt go nearer the finiſhing the deſign, and corrode more in ſmall works than in great, as even from the ſketch which may be made with it, there appears enough done for the taſte of men of judgment; and the graver ſhould only be employed to render it more agreeable in the eyes of the public, of whom the far greateſt part are not enough converſant in deſign, to be any way ſenſible of the effect of ſpirit. This was not unknown to the celebrated Mr. Picart, whoſe firſt deſigns, though leſs charged with work than the others, ſhewed yet enough of it; but ſeduced by the applauſes of the multitude, he gave himſelf up at laſt to a heavy and laboured manner; and not content to take away all the merits of his heads, by working with little needles, he loaded his draperies with hard and inelegant ſtrokes, and even puſhed his extreme paſſion for high-finiſhing to ſuch an exceſs as to attempt to expreſs the different colours of cloaths; which, in ſmall, was attended with the deſtruction of all the taſte and ſpirit of the performance. His productions, ſo long admired by the vulgar, (though on other accounts valuable by the elegance and extenſiveneſs of his genius) were for this reaſon never comparable to thoſe in which are found the pleaſing negligence of *La Belle*, the ſprightly touch of *Le Clerc*, or the ſportive and picturesque point of *Gillot*.

Where

Where a work, greatly advanced towards the finiſhing with *aqua fortis*, is deſired to be given with ſpirit, the needles ought to be often changed on the fore-ground; and, to give more character to things that are ſuſceptible of it, they muſt be engraved by ſtrokes ſhort, detached, and drawn firmly along the muſcles, or draperies, of which they form a part; for the long and united ſtrokes give a finiſhing that is cold and without taſte. The cloſer the ſtrokes are brought, the more the engraving appears valuable, provided that it be done judiciouſly, in obſerving the degradation of objects on the fore-ground with thoſe that are more diſtant, and of things that are detached from what ſerves them as a ground. It is for this reaſon engravings are made with fine and cloſe ſtrokes, to produce a work that may be liked; or, at leaſt, that may be conformable to the taſte of the preſent age; where, in general, they eſteem engravings in ſmall, only in proportion as they appear to be made with fine ſtrokes, as if merit conſiſted only in having good eyes and much patience.

The outlines ſhould be deſigned in a manner a little ſquare; they ought not to be obſcure, but diſtinctly viſible. Much pains is now taken to form them only by ſtrokes, which approach to the place of them. This manner may, perhaps, be good in larger works; but it is very faulty in ſmall, becauſe it gives too much ſoftneſs to the outlines,

lines. It may be juftly repeated and maintained, in fpite of the vogue and the bad tafte now prevailing, that engravings in fmall ought to partake of the nature of a fketch, and that the more they are finifhed, the more they are robbed of their principal merit, which confifts in fpirit and the boldnefs of the touch. There ought to be only few points or dots ufed in finifhing the flefh. Some works, in fmall, are to be found, that have otherwife value, but in which the flefh is loaded with points fo near each other that the lights appear as fhining as bronze, which occafions the draperies that are worked in a different manner to appear too much neglected. Nothing but motives of intereft, and the defire of pleafing men who have no knowledge of defign, could be inducements to purfue fo bad a manner, fince every thing may be as well done with much lefs labour; and in the arts which relate to defign, the merit of all work is in proportion to its appearing executed with eafe and fimplicity. In engraving in fmall, it fhould be avoided, likewife, to give too much attention to delineating all the particular parts of the head, as in great. Some little ftrokes, touched as a mafter, form pretty heads, and even expreffes the paffions better than all the pains that can be beftowed, to mark the ball of the eye, the eye-lids, the noftrils, and other minuter parts. It is true that this draws more admiration from the multitude,

titude, or from thoſe learned perſons whoſe proficiency in other ſciences makes their deciſions be conſidered as of importance in an art which they do not in the leaſt underſtand. But this extreme high finiſhing is only a ſlavery, from which an able artiſt ought to free himſelf, and which is advantageous only to men of moderate talents, and who have not abilities to ſucceed with leſs expence. Figures, ground, and other things, which ought to appear at a great diſtance, are engraven almoſt entirely with the ſame needle, except the moſt tender parts. The needle ſhould not cut too much, for fear the touches may make holes, or ſharpneſſes, which deſtroy all the effect in ſmall, and are extremely difficult to be taken out; becauſe, in order to do that, it is neceſſary to efface all the parts round them, which can never be ſo well re-placed by the graver.

When the fleſh is finiſhed by the graver, it is difficult to make uſe, with ſucceſs, of ſuch needles as are long-pointed, and yet more of ſuch as are extremely ſhort, otherwiſe they would make a fleſh that would ſeem covered with ſkin. Scarcely any thing but needles, rounded at the point, ſhould be employed in preparing the plate with the *aqua fortis*, except that in the ſhades of the fleſh, the engraving may be made with a ſtroke or two by thoſe which have long points. Something may alſo be hazarded, as to the ſtrokes of the third order, in the things

 which

which ought to be much compounded, as clouds, ground, and other places, that are conſidered of no importance, but to ſerve as back-grounds for other objects. But they ſhould be engraved with a very ſmall needle, with the intention that they may be leſs corroded than the others. In ſhort, this ſhould be ſo managed that the plate may be intirely finiſhed with the *aqua fortis*, if poſſible, in order to preſerve all the ſpirit of the deſign; for the more the work of the *aqua fortis* is put into it, the more certain it will be of ſucceeding, provided it is done judiciouſly and with taſte, and that it is not ſuffered to be too much corroded. This is the way to pleaſe able men, and true connoiſſeurs, whoſe approbation is gratifying, and deſirable to ſuch as aim at perfection, and to acquire a ſolid reputation.

SECTION XIII.

Of the preparation and compoſition of aqua fortis *proper for each kind of engraving.*

THE *aqua fortis*, uſed for the ſoft varniſh, is ſpirit of nitre, ſuch as is uſed by the refiners, and which may be beſt prepared in the following manner.

"Take

"Take of crude nitre, (commonly called "rough petre) the white kind, or of refined "ſalt petre, twenty-four pounds. Put it into "a retort, of which it will fill about two-"thirds, and add to it twelve pounds of oil "of vitriol. Place the retort in a ſtrong ſand-"heat, where it may be as low as the proper "turn of the neck will admit, and lute "on to the retort a very large receiver, con-"taining about a gallon of water. Diſtil "over all that will riſe, firſt with a gentle "heat, and then with a ſtronger, as the "quantity ariſing may ſhew to be neceſſary, "taking care that the receiver be not vio-"lently heated. When the whole is cold, "take off the receiver, and pour the *aqua* "*fortis* into a bottle, where it may be per-"fectly well ſecured by a glaſs ſtopper. It "is indifferent whether crude nitre or ſalt "petre be uſed, except with regard to ex-"pence, the firſt being much cheaper than "the other."

This is the ſpirit of nitre, ſuch as is uſed by the refiners, (except that it is not purified with ſilver, as is practiſed by them, which is unneceſſary for this purpoſe) and is the kind commonly employed for engraving. But it requires, before it be applied in that intention, to be lowered by the addition of half its weight, or more, of water. It may, however, be greatly improved for this purpoſe by compounding it with oil of vitriol, in the proportion of one part of the oil of vitriol

to nine or ten of the ſpirit of nitre, which makes an *aqua fortis* that will conſume the copper more keenly and cleanly than a purer ſpirit of nitre, without leaving any roughneſs or froſted appearance in the lines, which is ſometimes found where the *aqua fortis* does not well perform its office. Where this compoſition of oil of vitriol and ſpirit of nitre is uſed, it is proper, however, to augment the proportion of water, which, inſtead of being as two parts to one, may be as five to two, or it may be too active for the purpoſe.

The *aqua fortis* for the hard varniſh, according to Le Boſſe, may be thus prepared: "Take three pints of vinegar, ſix ounces "of *ſal ammoniacus*, the ſame quantity of "common ſalt, and four ounces of verdi-"griſe, or in proportion according to the "quantity of *aqua fortis* that is wanted. "Pound the ſolid ingredients very ſmall, "and put the whole together into a var-"niſhed earthen pot, of a ſize larger than "will contain them, that there may be "room for them to boil without over-"flowing. Cover the pot with its lid, "and then place it on a ſtrong fire, and "make the whole, as quickly as poſſible, "boil up two or three times, and no more. "When the matter appears ready to boil, "but not ſooner, uncover the pot, and ſtir "the whole together from time to time "with a ſmall ſtick, taking care, when the

"ebul-

" ebullition riſes ſtrongly, that the *aqua fortis* " do not boil over; for which reaſon the pot " is adviſed to be large, becauſe, commonly, " when the mixture begins to boil it ſwells " and riſes greatly. Having boiled up three " times, the pot muſt be taken from the fire, " and the *aqua fortis* left to cool in it; and " being cold, it muſt be poured into a bottle " of glaſs or ſtone-ware, keeping it a day or " two before it be uſed. If in making uſe of " it, it be found too ſtrong, and that it turns " the hatches into paſte by ſo ſcaling the " varniſh, nothing more is required than to " moderate it, by mixing a glaſs or two of " the ſame vinegar of which it was made." So far Mr. Le Boſſe.

Diſtilled vinegar has been recommended as being very excellent for making this *aqua fortis*, and is ſaid not to be ſo apt to make the varniſh ſcale. But I ſee no reaſon for this preference, becauſe the common vinegar is ſtronger than the diſtilled, and will produce a more perfect incorporation of the ingredients; and if the effect of ſcaling the varniſh reſult, it can only be from the *aqua fortis* being too ſtrong, which may be eaſily remedied by the addition of a ſmall quantity of water, if Mr. Le Boſſe's expedient of putting more vinegar does not anſwer the end. The water, in this caſe, will not produce the leaſt inconvenience, as it will incorporate with the mixture, without making the leaſt change in, or ſeparation of, any of the ingredients, ex-

cept by rendering the activity of the whole less.

This composition is not, properly speaking, *aqua fortis*, but called so, in this particular application, from performing the office of the true *aqua fortis*, which is a composition of the acid spirits of nitre and vitriol, without any metallic or saline substance; whereas this mixture does not contain a drop of either, but is composed, besides the vinegar, of copper, *sal ammoniacus*, and common salt, ingredients of a very foreign nature to those which constitute the true.

Mr. Cochin observes that this kind of *aqua fortis*, though deemed to belong to the hard varnish, is, nevertheless, excellent also when used on the soft; and he asserts, if any will make trial of it, they will find it much better than that of the refiners; and further, that it is not so subject to make the varnish scale, nor to several other disadvantageous accidents; as for example, the being prejudicial to the sight and health.

SECTION XIV.

Of the mixture of tallow and oil for covering the plates, to ſecure them from further corroſion, when neceſſary.

THE mixture for ſecuring the plates from further corroſion is, according to Mr. Le Boſſe, thus made:

" Take an earthen-ware pot varniſhed, " of a greater or leſs ſize, in proportion to " the mixture that is to be made, and put " into it ſome olive oil, and place it on the " fire. When the oil is hot, throw into it " the tallow of a candle, which being " melted, ſome of the mixture muſt be " taken out with a pencil, and dropt upon " any thing hard and cold; as for example, " on a plate of copper. If the drops are " found moderately fixt and firm, it is a " proof that the proportion of tallow and " oil is well adapted; but, if it be too liquid, " the obvious remedy is the adding more " tallow; and, on the contrary, if it be too " ſtiff, more oil muſt be put to it. Having " accommodated the mixture properly, it " ſhould be very well boiled for the ſpace " of an hour, in order that the tallow and " oil may be well mixt and incorporated " together; the boiling may be continued " till the mixture become red, or approach-

" ing to it, as otherwiſe the ingredients are
" apt to ſeparate when they are uſed."

The reaſon why oil is mixt with the tallow, is only to render it more liquid, and to prevent its ſetting ſo ſoon; for it is evident, that if tallow was melted alone, it would be no ſooner taken up by the pencil than it would grow hard, and ſet before it was brought to the neceſſary place of its application.

More oil ſhould be put to the tallow in winter than in ſummer.

Mr. Cochin obſerves, that the uſe of the mixture of oil and tallow, which is generally employed for covering the plates in the places where the *aqua fortis* is to be prevented from corroding further, requires much care and application in taking the *aqua fortis* ſo often from off the plate, and in waſhing and drying at the fire, which demand a conſiderable ſpace of time, and delay the proceeding with the corroſion. He therefore propoſes a new mixture, which has this advantage, that it may be put, with the end of the finger, in the places where there is occaſion for it, without taking off the *aqua fortis*, but while even it is acting on the plate. This mixture is as follows:

" Take equal parts of wax and turpentine,
" as much olive oil as both of them together,
" with the ſame quantity of hog's lard. Melt
" the whole over the fire in an earthen veſſel,
" taking care to mix the ingredients well,
" and

"and leave them to boil ſome time, till they "be well incorporated together."

The advantage of this mixture is, that it may at any time, being warmed, be put with the finger on the places deſired to be covered; by which means, the further operation of the *aqua fortis* on ſuch places, may be inſtantly prevented, without any other trouble or preparation, or without interrupting or delaying the principal operation.

This mixture may be employed equally well with the hard as with the ſoft varniſh; as the intention of uſing ſuch a compoſition, and the manner of applying it, which will be explained in its proper place, are the ſame in both caſes.

SECTION XV.

Of the method of putting the plate in a proper ſtate to receive the aqua fortis, *and of pouring it on the plate; with the manner of applying the compoſitions for preventing the ſweetenings, lights, &c. from being corroded beyond the due degree.*

THE method formerly uſed for this purpoſe, and given by Mr. Le Boſſe, is as follows.

The

The plate being properly engraven, and ready to undergo the operation of the *aqua fortis*, the compoſition of tallow and oil, given in p. 151, muſt be warmed till it be melted. Then, with a larger or ſmaller pencil, according to the ſize of the places that are to be covered, it muſt be applied upon all thoſe parts which it is deſired the *aqua fortis* ſhould not act upon; and, to anſwer this purpoſe effectually, it ſhould be laid on pretty thick.

This being done with a hog's hair bruſh, or other ſuch inſtrument dipt in the mixture, the reverſe, or back of the plate, ſhould be rubbed over; as alſo the edge, in order that they may not becorroded by the *aqua fortis*. The failing in this would not indeed be ſo injurious to the plate as to the *aqua fortis* itſelf, with regard to its further uſe. But great care ſhould be taken that the mixture be not too fluid; for, if it be ſo when the *aqua fortis* is poured on the plate, it will make it move, and leave the place where it was at firſt put. For this reaſon the mixture ſhould be, as I have ſaid, proportioned, as to the quantities of the ingredients, in ſuch manner that, as ſoon as it is laid on, it ſhould ſet to a firm conſiſtence.

Mr. Le Boſſe ſays, that it was his uſual practice to put, from time to time, a little of the mixture on his left hand, eſpecially in winter; that, holding it there, it might be kept half melted by the heat of his hand; which is a much more convenient way than

to

to have occaſion to melt it continually in the veſſel that contains it. He ſays, alſo, that it has ſeveral times occurred to him, but more particularly in uſing the ſoft varniſh, that the *aqua fortis* has carried it all off the plate in a moment. Having endeavoured to diſcover the cauſe of this accident, he once found, in raiſing the plate from the table, after having worked on a very cold day, that it was all wet on the back, which made him imagine ſome moiſture might probably have got betwixt the varniſh and the copper. This induced him to make a trial of the matter, by working on two plates, varniſhed both in the ſame manner; of which he held one to the fire, to diſſipate the moiſture before he put the *aqua fortis* upon it, which ſucceeded very well; but the other, which was not ſo treated, miſcarried by the ſeparation of the varniſh from the copper, as he had concluded it would. For this reaſon it is neceſſary, eſpecially in winter, to hold the plates to the fire, to dry them thoroughly before they undergo the corroſion; and more particularly, when the ſtrong *aqua fortis* is to be uſed it being a matter of great importance to the ſucceſs of the work. There is another thing he likewiſe adviſed to provide againſt, though it does but ſeldom happen. It is, that the copper is ſometimes (as it were) fat in its nature in ſpots, which prevents the varniſh from taking hold of it, although it ſeems to adhere properly; and the copper therefore cannot properly be diſtinguiſhed to be

be thus faulty till the *aqua fortis* be put on. For, if the *aqua fortis* be poured ſeven or eight times on theſe fat places, when they are engraved upon, the colour of the copper appears more red there than in other parts where it is not fat, and the varniſh is very ſubject to peel off from them. There is no remedy againſt this, when matters are gone ſo far, but to finiſh the plate with the other kind of *aqua fortis* made with good vinegar.

When the plate is thus prepared, by covering the proper parts of it with the mixture of tallow and oil, it ſhould be laid on the board or frame deſcribed in p. 81, and placed againſt a wall, or ſome other body which may keep it firm in a ſloping poſture. The trough deſcribed there alſo, ſhould then be ſet at the foot of the board; and the earthen pot, or other veſſel to receive the *aqua fortis* as it runs off, placed under the trough; but it muſt be raiſed as near it as poſſible, that the ſtream of the *aqua fortis* falling out of the trough may not make a ſpray. For, that riſing over the ſides of the pot, would waſte the *aqua fortis*, or make ſuch a foam in the pot as would be inconvenient when it comes to be poured again over the plate.

The whole being thus fixt, a proper quantity of the *aqua fortis* muſt be put in an earthen pot, or other proper veſſel; and, by means of a leſſer veſſel, convenient for lading it out of the other, it muſt be poured on the plate, at the upper end, in ſuch manner that flowing

ing down every part of the plate, it may be equally covered, taking care not to touch the varniſh with the pot. The *aqua fortis* running down the plate will be collected in the trough, and thence fall into the veſſel placed underneath to receive it; from whence it muſt be returned ſeven or eight times on the plate, proceeding as in the firſt. The plate muſt be afterwards turned, ſo that the other end may be uppermoſt, and the *aqua fortis* again poured ten or twelve times over in the like manner as before. The ſame muſt be done by the two ſides, the operation being continued, ſtill turning the plate, after eight or ten pourings on for the ſpace of half a quarter of an hour, or more or leſs, according to the force of the *aqua fortis*, or the readineſs of the copper to ſuffer the corroſion; for if the copper be ſhort or brittle, the *aqua fortis* muſt be poured a leſs time; and, if it be ductile, it may remain a longer. As it is not eaſy to know certainly the ſtrength of the *aqua fortis*, nor the peculiar quality of the copper, the following method is given for regulating the matter according to the force and the due corroſion that is intended to be made upon the plate; for in ſome inſtances the plates require a much ſtronger, and in others a much gentler effect of the corroſive action. The method is, to pour the *aqua fortis*, in the manner juſt directed, for the firſt time half a quarter of an hour, and then to take away the plate, and to pour water on it copiouſly, from a veſſel raiſed to ſome diſtance

above

above it, to waſh it till it is intirely freed from the *aqua fortis*; for, if it be not well waſhed, when it is dried the varniſh will appear green, and hinder the work from being diſtinctly ſeen. Afterwards the plate muſt be put before a clear fire, in ſuch manner that, without melting the mixture of oil and tallow which may be upon it, the fire may dry away the water. This being done, the varniſh muſt be rubbed with a little piece of coal in ſome place where there are fine ſtrokes or hatches. If it be found that the *aqua fortis* has corroded the ſweetenings ſufficiently, ſome of the mixture of oil and tallow muſt be melted; and the plate being put on a painter's eaſel, or other ſuch convenient thing, the diſtances and other places, where the hatches are deſired to be tender and ſoft, ſhould be covered with the mixture by means of a pencil, as if it was to be painted with it. This ſhould be done as well on the part that has been rubbed with the coal as the others, where a further corroſion is improper, remembering that the mixture ſhould be always ſpread thick enough on the places that are wanted to be covered with it; as it is not ſufficient that the pencil ſhould be only greaſy, to rub over the hatches, but it ſhould be well charged with the mixture, and cover the places with it as if they were painted. Regard too muſt be had that it ſhould be particularly done in this manner, the firſt time the tender and ſoft hatches or ſtrokes are covered. After having (if it be in winter) ſet the

plate

plate before the fire to dry away all moiſture, it ſhould be put again on the board, and the *aqua fortis* thrown over it as before, for the ſpace of about half an hour, turning the plate every way from time to time. The plate ſhould be then waſhed with common water, and dried at the fire, as the firſt time, without melting the mixture of oil and tallow, which ſhould be carefully avoided, or otherwiſe the work runs the hazard of being ſpoilt.

The plate being then dry, it ſhould be put again upon the eaſel, and the hatches and diſtances, which are next in force to the weakeſt, covered with the melted mixture of oil and tallow in the ſame manner as the others were before. But it may happen, that in drying the plate by the fire after it has been waſhed, the mixture of oil and tallow may by accident be melted, and run into the hatches that are required to be ſtill more corroded by the *aqua fortis*. In ſuch caſe the places ſhould be wiped with a ſoft linen cloth, and then well rubbed with the crumb of very ſtale bread, till ſuch time as it may be concluded the greaſe is entirely taken off, that the *aqua fortis* may not be prevented from operating properly, which is a reaſon why the utmoſt care ſhould be taken this accident may never occur at all.

In order to proceed with the corroding the plate that is thus covered once more in the proper parts with the mixture, it muſt be again put upon the board, and the *aqua fortis* poured upon

upon it for half an hour. This being done, it ſhould be waſhed with clean water and dried, as in the other caſes, and then covered, for the laſt time, in the places remaining neceſſary. For it is obvious, that according to the nature of different deſigns and the work with which they are executed, there are more or leſs ſoftenings and ſweetenings to be made. After this laſt covering, the *aqua fortis* muſt be again poured over it as before, but for a longer continuance, which muſt be regulated by the occaſion; for neither at this laſt time, nor after the covering the diſtances and ſweetenings can any preciſe rule be given; and the means of judging occaſionally can only lie in experience, and making repeated examinations during the operation, by laying proper parts of the plate bare in the manner above adviſed, to ſee the effects of the *aqua fortis* from time to time.

The corroſion having been thus continued for a ſufficient time, which in many caſes will be about an hour, the plate muſt be again waſhed with common water; but it is not neceſſary to dry it as before, even if it was intended to pour yet more *aqua fortis* upon it; and nothing more is required than to ſet it wet as it is over the fire till the mixture of oil and tallow put upon it be intirely melted; and then wipe it thoroughly clean with a linen cloth, both on the right and wrong ſides, till the mixture be intirely taken off from every part.

Mr.

Mr. Cochin mentions a method uſed by Mr. Le Clerc, for flooding the plate with the *aqua fortis*, more ſimple and eaſy than his own we have been giving, which is this: He had a tray or cheſt of a convenient ſize, of which the ſides were about three or four inches in height, and of very thin wood well joined together, and caulked on the outſide with rolls of paper. This tray was painted with oil as well within as without, that it might hold the *aqua fortis*, without imbibing any of it. When the corroſion was to be made, the plate was greaſed on the under ſide, and being placed in the bottom of this tray, the *aqua fortis* was poured into it till it roſe to the height of a line or two. The tray was then ſhaken with a ſoft and gentle motion, to make the *aqua fortis* paſs and repaſs over the plate. This was done by taking the tray on the knee; or if the plate was large, by placing it in equilibrio on a round thick ſtick put upon a table, by either of which means it could be raiſed by a ſlight motion, firſt at one end and then at the other, to make the *aqua fortis* flow over the plate as often as was deſired; or, inſtead of a ſtick, he uſed any thing elſe that could anſwer the purpoſe, and was moſt eaſily procured.

If the plate was warped, and would not lie flat on the bottom of the tray, but ſuffered the *aqua fortis* to paſs under it, he faſtened it down with pins or ſmall nails till it lay level; and if it was large and heavy, he put others to

hinder it from ſtirring or gliding out of its place, taking care always to greaſe well the pins or nails that were employed for this purpoſe.

When the plate was taken out to waſh it, in order that any thing neceſſary might be done, it was held declining over a ſink, and water was poured gently over it ſeveral times. For experience has ſhewn, that being ſuffered to fall upon it from a higher diſtance, as Mr. Le Boſſe adviſed, was frequently injurious, as it often crackt the varniſh, and rendered it incapable of reſiſting afterwards the *aqua fortis* for any length of time, without ſeparating from it before the plate was ſufficiently corroded. The plate being thus waſhed, he let it drain a ſhort time, and then having placed it on a table, a ſheet of foul paper, or ſome print that had miſcarried was ſpread over it, and preſſed gently upon it with a handkerchief. This paper was then lifted off carefully, and another put in its place, which intirely ſucked up all the water remaining on the plate that had been left by the firſt; and after this he held the plate a moment or two to a ſlow fire to take away any, even the leaſt damp that might be left on it. In the caſe of the ſoft varniſh and the refiners *aqua fortis*, Mr. Cochin recommends the following method to be purſued for managing the plate, pouring on the *aqua fortis*, and ſpreading the defenſative mixture over the proper parts.

Take

Take ſoft ſealing-wax, ſuch as is uſed for the putting ſeals of office to writs, grants, &c. (whether it be coloured or not is not material) and ſoften it at a fire if it be uſed in winter; but in ſummer it may be made ſufficiently ſoft and pliable by working it with the hand. Having thus prepared the wax, lay the plate on a table, or any other flat ſurface where it may be duly level, and raiſe upon the edge of it, where there is nothing engraved, a ſmall border of the wax, of about an inch high, in the reſemblance of a little wall or rampart, and carry it round the plate in ſuch manner, that, the *aqua fortis* being poured within, it may be detained upon the plate, and prevented from ſpreading or running off at any part. In winter it is proper to heat ſome of the wax to apply along the joints of the plate and this border, in order to render them more tight and impervious to the *aqua fortis*. But let it be remembered, before this border be put round the plate, to dry it well at the fire, to prevent any water being harboured betwixt the varniſh and the copper, for the reaſons above given, which are particularly cogent with reſpect to the ſoft varniſh.

At one of the corners of this border a gutter is uſually made, which ſerves for pouring commodiouſly the *aqua fortis* over the plate; and the ſides of this gutter are to be made higher than the reſt of the border, in order that in declining the plate to pour off the *aqua fortis* into the veſſel deſigned to receive it, it may

not run over the border. There are ſome who cover the ſides of the plate where the wax is fixt with the mixture of oil and tallow, to ſtop any little holes through which the *aqua fortis* might eſcape under the wax; but this method is injudicious, and fouls the hands when the wax is to be handled, in order to the taking it off to ſerve for another time; for which reaſon it is much better to fix the wax to the copper when it is well ſoftened, and render it adheſive by the fire; and while it is yet ductile, to run the finger along the joint that the wax makes with the copper, by which means it may be cloſed in the moſt perfect manner.

The plate being thus bordered, take a due quantity of the refiners *aqua fortis*, pure and good, and mix it with half (or more) of its quantity of common water; or where there is *aqua fortis* that has been uſed before, (which may be eaſily diſtinguiſhed by its blue colour) it may be employed in the place of common water for mixing with the freſh; in which caſe allowance muſt be made for the ſtrength.

Of the *aqua fortis* thus prepared, pour gently then through the trough or gutter made at the corner of the border of wax put round the plate, as much as will riſe a finger's breadth above the plate. Then if all things have been rightly conducted, it will be ſeen that the *aqua fortis* will quickly exert its action in the hatches which have been ſtrongly touched, but thoſe more weakly engraved will ap-

pear

pear at firſt clear, and of the colour of the copper, becauſe it has not ſoon any operation on them that is very perceivable by the eye.

When it has appeared that the *aqua fortis* has for ſome time acted with vigour on the ſtrong touches, and that it begins to take effect on the tenderer parts, it ſhould be ſuffered to corrode only a very little more; and it may be eaſily examined if the *aqua fortis* has done its office, by laying bare a proper part by a piece of coal, in the manner before mentioned. The *aqua fortis* ſhould be then poured into a veſſel of ſtone ware; and water ſhould be immediately put upon the plate, to take off or weaken any that may remain on the plate in the engraved parts, and then the plate ſhould be dried in the way before adviſed. The plate being again in this ſtate, take ſome of the mixture of the oil and tallow, deſcribed p. 151, and cover the lights, &c. as Mr. Le Boſſe has adviſed in works of leſs conſequence. And where diſpatch is wanted, it is better to take ſome of the other compoſition of wax, turpentine, &c. and having melted it, to lay it on with the end of the finger, or by means of a pencil, over the parts to be covered, which may be done without waſhing, or any other preparation than pouring the *aqua fortis* off the plate.

The proper places being covered by either of theſe methods or compoſitions, the *aqua fortis* muſt be again put on it, and left there for the ſpace of half an hour, or a longer or

ſhorter time, according to its ſtrength, or the nature of the work; and then it muſt be taken off as before, and water immediately thrown on the plate.

It is proper to obſerve that, when the *aqua fortis* is on the plate, the feathered part of a quill ſhould be uſed, to cleanſe away the foulneſs or verdigriſe that gathers in the hatches when the *aqua fortis* operates on them, and to give a freer room to exerciſe its action, as alſo to be able to perceive it, if the varniſh ſhould crack, which the ebullition of the *aqua fortis* otherwiſe hinders from being ſeen. This is done by moving the *aqua fortis* to and fro on the plate by the feathered part of the quill, and bruſhing away the black ſaline matter where it appears to be formed.

The ſealing-wax above-mentioned by Mr. Cochin, and of which he has omitted to give the preparation, being moſt probably ignorant of it, may be beſt made by the directions given in p. 38, for the yellow kind of ſoft wax; and it may be rendered harder or ſofter in the original compoſition, according as the ſeaſon or the occaſion may make expedient, by diminiſhing or encreaſing the proportion of reſin.

The practice of uſing the ſame *aqua fortis* over again in the place of water, is certainly a bad one; as, being replete with the verdigriſe or ſalts of the copper, it cannot fail to fill the hatches much ſooner with foulneſs of that kind, when the freſh *aqua fortis* acts along with it,

than

than when water is uſed. From whence it is evident, as this is attended with the inconvenience, mentioned by Mr. Cochin, of obſtructing the operation, and preventing the effect from being viſible, that it is better to uſe water only for diluting the *aqua fortis*.

The *aqua fortis*, formed by adding oil of vitriol to ſpirit of nitre, of which the preparation is given in p. 147, and which is much the beſt of any of that kind for engraving, requires to have more than half its weight of water added, as well becauſe it is ſtronger of itſelf than that which is to be met with in ſhops, as on account of the greater activity it receives from the addition of the oil of vitriol.

SECTION XVI.

Of the manner of taking the varniſh off the plate, when the corroſion by the aqua fortis *is finiſhed.*

WHEN the ſoft varniſh is to be taken off, after the finiſhing the corroſion, the plate muſt firſt be warmed at the fire, and the border of wax round it removed away. Then it muſt be made hotter till the mixture or compoſition, as well as the varniſh melt, when it muſt be well wiped with a clean linen cloth, afterwards rubbed heartily in every

part with oil of olives; which being performed, it is ready to be re-touched by the graver, if there be occasion.

The manner of taking off the hard varnish, according to Mr. Le Bosse, is as follows:

Choose a very soft coal of sallow wood, and, without burning it, strip off the bark, and then dipping it in water, of which some likewise should be poured on the plate, rub the varnish with it, but continually the same way as in polishing the copper, which will take off the varnish. Be particularly careful, nevertheless, to prevent any gravel from falling on the plate; as also to observe that there be no hard grains in the coal, for either of these would make scratches on the plate, which would be very difficult to be effaced, especially upon the tender parts and sweetenings. This is a reason why the coal used for polishing should not be applied to this purpose, as it would injure the tender parts, by wearing them away in some degree; and the coal which is not burnt a second time does not take upon the copper, or but in a very slight degree.

When the varnish is all taken off from the plate, the copper remains of a disagreeable colour, from the effect the fire and water have had upon it; but, in order to restore it to its usual appearance, use this method: Take of the refiners *aqua fortis*, and, if it be pure, put two-thirds, or more, of water to it. Then take a linen rag dipt in the *aqua fortis* thus lowered

lowered with water, and rub with it all the engraved parts of the copper, by which it will be ſoon found to become bright and clean, and of the common colour of copper.

Wipe the plate immediately after this with another linen rag that is dry and clean, till not the leaſt of the *aqua fortis* and water remain on it, and pour upon it afterwards a little olive oil, and with a ſmall piece of old hat, or other ſuch thing, rub the oil ſtrongly over every part of it. After this, clean the plate with a linen cloth, being cautious not to employ the rag for that purpoſe, which had been before uſed to wipe off the refiners *aqua fortis*.

It may then be ſeen fairly whether there be occaſion or not to re-touch the plate with the graver, as it frequently happens there is a neceſſity for doing, eſpecially in the places which ought to be very brown; for it is eaſily conceivable, that when there is many hatches one upon another, there ſcarcely remains any varniſh betwixt them; and, conſequently, it often happens that the *aqua fortis* takes away what little ſubſtance there is, and, by corroding under it, reduces the whole to a paſte or ſhell. If, however, it ſhould at any time be found that this accident had occured in corroding with the *aqua fortis*, the place which is flawed ſhould be immediately covered with the mixture of oil and tallow, or wax and turpentine. It is much more eaſy, when this is done, to repair the defective part

part with the graver, than when the *aqua fortis* has made a hollow, that in printing at firſt produces a black ſpot, and after ſome few impreſſions a white one, becauſe the printing ink will not any longer ſtick to it. If the injured part be thus covered in good time, nothing more remains neceſſary than to repair, with the graver, the ſtrokes and hatches, to ſtrengthen them by the method taught in the firſt chapter, where the manner of engraving with the tool is treated of.

SECTION XVII.

Of the method of re-ingraving, by means of aqua fortis, *what may have been at firſt forgotten, or may be deſired to be added after the plate has undergone the operation of of the* aqua fortis.

IT frequently happens that ſomething has been deſigned in the engraving on the varniſh that does not afterwards give ſatisfaction, and has therefore been covered with the mixture of oil and tallow during the corroſion, in order that the *aqua fortis* may have no effect upon it; or even after the finiſhing the work as firſt deſigned, it may be deſired to add ſome additional part, as in the inſtance of

of draperies, and on many other occaſions that occur. In any ſuch caſe, the plate muſt be rubbed well with olive oil on the engraved places, that the printing ink, or foulneſs of whatever kind, which may be in any of the hatches, may be taken out, and then the whole muſt be freed from the greaſineſs of the oil by the crumb of ſtale bread, till not the leaſt, either of greaſineſs or dirt, may remain on the ſurface, or in the hatches.

Heat then the plate over a charcoal fire; and, having put the ſoft varniſh upon it, ſpread it with the ball of taffety filled with cotton, as has been above directed. The greateſt object of care in ſo doing is, that the hatches which are intended to remain may be filled with varniſh. This being done, blacken the varniſh in the manner above deſcribed, and then engrave whatever omiſſion or addition may be judged proper. Corrode then the plate the ſame way as before, taking care, before the *aqua fortis* be put on, to cover what may be neceſſary with the mixture of oil and tallow, in the manner directed for the former corroſion, as likewiſe all the firſt engraving. This is very neceſſary for fear the varniſh might not ſecure every part from the *aqua fortis*, and that the whole may be rendered more ſafe by this means; as, if there ſhould be any hatches that might happen to be neither covered with the varniſh nor mixture, the *aqua fortis* would cer-

tainly

tainly get into them and ſpoil the plate. Having finiſhed the corroſion, the varniſh muſt be taken off the plate, by means of heat, in the manner before directed in the caſe of the ſoft kind.

CHAP. V.

Of ſcraping mezzotintos, and the applying that art to the production of coloured prints reſembling pictures.

SECTION I.

Of the general nature of ſcraping mezzotintos.

THE ſcraping mezzotintos is a kind of engraving which is executed by covering the ſurface of a copper-plate with lines, ſunk in it cloſe to each other, in different directions, ſo that it would, if uſed for printing in this ſtate, give a black impreſſion, or ground, from the whole; and then taking away or diminiſhing the effect of the ground, by ſcraping or burniſhing, according to the neceſſary expreſſion of any given deſign, ſuch parts

parts of theſe lines as brings the plate to the ſame condition, as if lines had been originally cut, correſpondently to the manner of other engravings, in thoſe places where they were wanted to expreſs the ſhades or darker parts of the deſign.

This appears, therefore, in one view, to be an oppoſite kind of engraving to the others, as in them the ſhades and darker parts are formed by the deſtroying part of the lights, of which the whole ground muſt be conſidered as at firſt conſiſting; whereas in this the ground being originally all ſhade, the lights are produced by deſtroying parts of it. As it is much eaſier to ſcrape or burniſh away parts of a dark ground correſpondently with the outline of any deſign ſketced upon it, than to form ſhades upon a light ground, by an infinite number of hatches, ſtrokes, and points, which muſt all terminate with exactneſs on the outline, as well as differ in their force and manner, the method of ſcraping in mezzotinto conſequently becomes much more eaſy and expeditious than any other method of engraving. For which reaſon it is of courſe much better accommodated to painters, or others, who are maſters of the deſign, and deſirous to engrave prints without the long application to attain the talent, and the labour and trouble afterwards required to exerciſe it, that attend the other methods. The forming the ground of the plate, which is part of the neceſſary work, is

is indeed laborious and tedious. But it may be thrown upon thoſe who are uſed to ſuch mechanical employments, as it requires little ſkill or judgment, unleſs what may be acquired by a ſmall ſhare of practice, being a matter only of care and application, and therefore no proper part of the buſineſs of the artiſt who is to ſcrape the deſign on the plate. There is, moreover, no doubt but that the ground of mezzotintos may be made by proper machines with much greater eaſe and accuracy than by the hand, as at preſent. The invention of a machine for this purpoſe would be a very high improvement of this art, and probably afford both honour and profit to the perſon who ſhould bring it to perfection. Not only the facility of the work, but the effect of it when finely executed, are great recommendations to this kind of engraving, as the extreme ſoftneſs of the teints, along with a great force of relief, renders the prints done this way, that are perfect, more generally pleaſing than thoſe engraved in any other manner, which the great number of portraits lately done evinces.

It is, however, only with regard to ſome kind of ſubjects that this ſpecies of engraving has this merit; portraiture is the great object of its excellence; and ſome landſkips have been done that are not contemptible. Horſes alſo have been attempted with ſucceſs; and ſome deſigns of hiſtory properly adapted may be brought within its reach. But, where any

thing

thing beſides the portraits of men, and other animals, come in queſtion, there muſt be a peculiar accommodation of the ſubject, as its powers, with reſpect to variety of expreſſion, are much leſs extenſive than thoſe of etching, and conſequently fall far ſhort of thoſe of the graver. The principles on which the fitneſs or unfitneſs of ſubjects for this kind of engraving are founded, are of two kinds; the one reſpecting the proportion of light and ſhade; the other the nature of the deſign with regard to the outline. Such pieces as contain large and clear maſſes of light do not ſucceed at all; but where, on the contrary, there is a large proportion of very dark parts, as in the repreſentations of night ſcenes, or a large proportion of brown ſhades, as in the pictures of Rembrant, Benedette, and Teniers, in ſome inſtances, the beſt effect is produced, and with the leaſt labour. Such pieces, likewiſe, as are of a ſimpler compoſition, and do not require great force and variety of expreſſion, as paſſion and character, are ſuitable. But, where great ſpirit and freedom are required to give merit, this manner of engraving fails, as it does not admit of thoſe ſharp and delicate ſtrokes and touches which are the means of that expreſſion.

SECT.

SECTION II.

Of the inſtruments uſed in ſcraping mezzotintos, and preparing the ground.

THE inſtruments employed in ſcraping mezzotintos, and the preparation of the plate, are *cradles* of two ſizes, the one for making, and the other for repairing the ground; *ſcrapers*, and *burniſhers*.

The cradle is a tool formed of ſteel reſembling, in its general ſhape, a chizzel with one ſloping ſide, upon which are cut hollow lines very cloſe to each other, but at diſtances as exactly equal as poſſible. The part of this inſtrument, which is to act on the copper, is made of a circular form, in order that it may be moved on the copper without catching; and the corners are alſo conſiderably rounded, otherwiſe they would mark more ſtrongly than in the middle, and make ſome ſpots or places more black than the reſt. When this inſtrument is thus formed, it is tempered in the manner practiſed by thoſe who prepare other edged tools, where great hardneſs is required (for which a method is before laid down in treating of the inſtruments for engraving, p. 54). This being done, it muſt be ſharpened on the whetſtone; when

when particular regard muſt be had to the proper rounding of the corners, if it be not done before. No lines are cut on the flat ſide, but the extremity of it being whetted to a very ſmall ſlope gives a very ſharp edge to the little teeth formed by the hatches or lines on the other ſide.

The leſſer cradle for repairing the ground, where any part having miſcarried there is occaſion to reſtore it, is the ſame with the other, but leſs; and indeed there ſhould be ſome of ſeveral ſizes, as the ſpots of the ground to be repaired may vary greatly on different occaſions.

The ſcrapers are formed much in the manner of a knife, except that the edge is ſtraight till near the point, and there ſlopes off at an angle from both ſides; the lines of which ſlopes meeting, form another angle of the print; but the ſlope on one ſide is made longer than that of the other.

The graving tool is a ſteel inſtrument, formed like a ſquare pyramid, ending in a ſharp point.

The burniſhers are the ſame as are uſed in the other kinds of engraving, but leſs, in order that they may efface more effectually whatever may require it, and that they may make ſtraight ſtrokes of light, without touching what may lie contiguous on either ſide.

The graving tools and burniſhers are frequently made in one piece; the one being at one end, and the other at the oppoſite.

SECTION III.

Of the manner of forming the ground on the plate, in order to the ſcraping in mezzotinto.

THE plate muſt be prepared and poliſhed according to the manner before directed for other engravings, p. 49, and afterwards divided equally, by lines parallel to each other, and traced out with chalk that is very ſoft, for fear it ſcratch the plate. The diſtance of theſe lines from each other ſhould be about a third of the length of the face of the cradle which is to be uſed, as not more than that proportion of the inſtrument, from its form, and the rounding of the corners, will take at the ſame time upon the copper; and theſe lines ſhould be marked by capital letters or ſtrokes of the chalk. The cradle is to be then placed exactly betwixt the two firſt lines, and paſſed forwards in the ſame direction, being kept as ſteady as poſſible, and borne upon with a moderate force. The ſame muſt be repeated with reſpect to all the reſt of the lines, till the inſtrument has been thus paſſed over the whole ſurface of the plate. Other lines muſt be then drawn from the extremities of the other two ſides in the ſame manner, which, interſecting the firſt

firſt at right angles, will conſequently, together with them, form ſquares; and the ſame operation muſt be repeated with the cradle as in the caſe of the firſt. New lines muſt then be drawn diagonally, or cornerwiſe, on the plate, and the cradle paſſed betwixt them as before; and when the firſt diagonal operation is performed, the lines muſt be croſſed at right angles as the former, and the cradles paſſed betwixt them in the ſame manner.

The plate having undergone the action of the cradle, according to the diſpoſition of this firſt order of lines, a ſecond ſet muſt be formed, having the ſame diſtances from each other as the firſt; but they muſt be ſo placed as to divide thoſe already made into ſpaces one-third leſs than their whole extent; that is to ſay, every one after the firſt on each ſide will take in one-third of that before it; as for example, beginning at A, of which the firſt third muſt be left out, a third of B will be conſequently taken in, and ſo of the reſt. Theſe lines of the ſecond order may be either marked with ſmall letters, or leſſer ſtrokes, to diſtinguiſh them from the firſt; and the ſame treatment of the plate, with reſpect to them, muſt be repeated as was practiſed for the others; and this muſt be underſtood to extend as well to the diagonal lines as thoſe parallel to the ſides of the plate.

When this ſecond operation is finiſhed, a third order of lines muſt be made; the

first of which, suppose in A for example, must omit two-thirds of it; and, consequently, take in two-thirds of B; and so of the rest; by which means the original spaces will be exactly divided into equal thirds; and the cradle must be again employed betwixt these lines, as before, in the case of the others.

When the whole of this operation is finished, it is called *one turn;* but in order to produce a very dark and uniform ground, the plate must undergo the repetition of all these several operations for about twenty times, beginning to pass the cradle again betwixt the first lines, and proceeding in the same manner through all the rest. But it may not be impertinent to repeat the caution that the cradle should not be too hardly borne upon, and that it should be passed cross the plate with one motion only, without stopping or varying the action, for fear of making spots or inequalities in the black of the ground, and that the grain may have the soft and velvet-like look in every part; on which indeed depends the beauty of this kind of engraving.

This uniformity of the ground is therefore of so much consequence that it should be examined, and even tried with the greatest care, before the scraping be begun; since, if it prove bad, there is no remedy; but the labour already bestowed on the work, when it shall be discovered to be so, must be

be given up, which is generally the beſt compromiſe; for, otherwiſe, with great pains and embarraſſment, a defective work will at laſt be produced, even though by the hands of the moſt ſkilful.

SECTION IV.

Of the manner of ſcraping in mezzotinto.

WHEN the plate is prepared with a proper ground, the ſketch muſt be calked on it by rubbing the paper on the backſide with chalk. But, as this kind of white is very apt to come off, and, conſequently the tracing made with it to be defaced, it is proper to overtrace it afterwards with black lead, or, what is better, Indian ink; for common ink is improper, as it remains in the grain, and is not to be got out without a great deal of trouble.

The ſcraping is then performed by paring or cutting away the grain of the ground in various degrees, ſo that none of it is left in its original ſtate, except in the touches of the ſtrongeſt ſhade. The general manner of proceeding is the ſame as in drawing with white upon black paper. The maſſes of light are firſt begun with; and thoſe parts, which go off into light in their upper part, but are

brown below. The reflections are then gradually entered upon, after which the plate is blackened with a printer's blacking ball made of felt, to see the effect; and then the work is proceeded with, observing always to begin every part in the places where the strongest lights are to be. But the greatest caution should be taken not to pare away the grain too fast in hopes of having sooner finished; for it is not easy to re-place it when it is once taken away, especially in the lights; and there ought always to remain every where a slight cast of it, except on shining parts. As it will, nevertheless, happen, after all possible attention, that the grain will be taken off more than is proper in some places, the little cradles of different sizes, spoken of in describing the instruments, are then called in aid to restore it.

SECTION V.

Of the application of the art of scraping mezzotintos to the printing with a variety of colours, in order to produce the resemblance of paintings.

THE art of printing such a variety of teints as may compose a painting without multiplying the plates to a proportionable number,

number, was eſtabliſhed by Mr. Le Blon upon this principle: That there are three primitive colours, of which all the reſt may be compoſed, by mixing them in various proportions;—that any two of theſe colours being mixed together, preſerve their original power, and only produce a third colour, ſuch as their compound muſt neceſſarily give; but if tranſparent colours be mixed, and the three primitive kinds compounded together, they deſtroy each other, and produce black, or a tendency to it, in proportion to the equality and inequality of the mixture;—and that if, therefore, theſe three colours be laid either ſeparately, or upon each other, by three plates, engraved correſpondently on theſe principles to the colouring of the deſign, the whole variety of teints neceſſary may be produced.

The requiſites, therefore, to the execution of any deſign in this method of printing, are as follow:

Firſt, To ſettle a plan of the colouring of the painting to be imitated, ſhewing where the preſence of each of the three ſimple colours is neceſſary, either in its pure ſtate, or combined with ſome other to produce the effect required, and to reduce this plan to a painted ſketch of each, in which not only the proper outlines, but the degree of ſtrength ſhould be expreſſed.

2dly, To engrave three plates correſpondently to this plan, which may print each

of the colours exactly in the places where, and proportion in which they are wanted.

3dly, To find three transparent substances proper for printing with these three primative colours.

The first of these requisites is the most difficult to be performed, as it requires a thorough comprehension of the nature of colours in this view, as well as some experimental skill and judgment to settle the necessary system, both of the simple and combined effects, in order to produce the due combination with harmony and proper keeping. The second is not so difficult as the first, if that be well executed, and requires more of care and labour, than of skill and judgment; but particular regard should be had, that the plates be exactly alike in dimensions and form, for the least irregularity or disproportion renders the whole attempt abortive.

The third can never be completed but in an imperfect degree, as we have not any such substances in the Materia Pictoria as correspond fully with what is here wanted; which is to have three pigments perfectly transparent, pure, or bright, and agreeing in their tone of force and colour. A blue we have, in the Prussian blue, when it is very good in its kind, that is not very exceptionable; and lake of the best sort (could it be procured) would afford a red, which, though not so near the proper standard as the

the beſt Pruſſian blue, might ſtill well enough ſerve; but for yellow, brown pink (which is the only tranſparent pigment deep enough for this purpoſe) has never been hitherto produced ſo as to correſpond, either for ſtrength of colour or brightneſs, with either fine lake or Pruſſian blue; and this muſt therefore be conſidered as an hitherto unobtained requiſite for carrying on this art to the firſt degree of perfection. Theſe three muſt, however, be the pigments employed; and the Pruſſian blue muſt be light in the pigment, otherwiſe it will greatly overpower both the others; but it ſhould be as bright as poſſible, to which quality deepneſs or ſtrength of colour ſhould be added likewiſe in the choice of the others for this purpoſe.

The method of engraving plates by ſcraping in mezzotinto had rendered this art of imitating painting more eaſily practicable, as far as regards the execution, with reſpect to the printing. For the ſeveral plates that are neceſſary to be engraved correſpondently to each other, are much ſooner done in this way than they could be in any other; and the particular manner Mr. Le Blon uſed in preparing them was as follows.

The three plates of copper were firſt well fitted, with reſpect to ſize and figure, to each other, and grounded in the ſame manner as thoſe deſigned for mezzotinto prints, and the exact place and boundary of each of the three primitive colours, conformably to the

the deſign, were, as above mentioned, ſketched out on three papers anſwering in dimenſions to the plate. Theſe ſketches were then calked on the plates; and all the parts of each plate, that were not to convey the colour to which it was appropriated to the print, were entirely ſcraped away, as in forming the lights of mezzotinto prints. The parts that were to convey the colour were then worked upon; and where the moſt light or diluted teints of the colour were to be, the grain of the ground was proportionably taken off; but where the full colour was required, it was left intire. In this, regard was had not only to the effects of the colour in its ſimple ſtate, but to its combined operation, either in producing orange-colour, green, or purple, by its admixture with one alone, and likewiſe to its forming brown, grey, and ſhades of different degree, by its co-operation with both the others. But though the greateſt part of the engraving was performed in the mezzotinto manner, yet the graver was employed occaſionally for ſtrengthening the ſhades, and for correcting the outline, where it required great accuracy and ſteadineſs. It was found neceſſary ſometimes to have two ſeparate plates for printing the ſame colour, in order to produce a ſtronger effect; but the ſecond plate which was uſed to print upon the firſt, was intended only to glaze and ſoften the colours in particular parts that might require it. With reſpect to

to the black and brown teints, which could not be ſo conveniently produced, in a due degree, by the mixture of the colours, umber and black were likewiſe uſed.

The explanation of the manner of printing with theſe plates will be reſerved till the method of printing in general with copper-plates is treated of. But with reſpect to the order in which the plates are to be applied, it may not be improper to obſerve here, that the colour which is leaſt apparent in the picture ſhould be laid on firſt; that which is betwixt the moſt and leaſt apparent next; and that which predominates laſt, except where there may be occaſion for two plates for the ſame colour, as was before mentioned, or where there is any required for adding browns and ſhades.

Mr. Le Blon applied this art to portraits, and ſhewed, by the ſpecimens he produced, the poſſibility of its being brought, by farther improvements, to afford imitations of painting which might have ſome value. It is, nevertheleſs, much better adapted to the ſimpler ſubjects, where there are fewer intermixtures of colours, and where the accuracy of the reflections and demi-teints are not ſo eſſentially neceſſary to the truth of the deſign, from the greater latitude of form, and diſpoſition of the colour, as in plants, anatomical figures, and ſome ſubjects of architecture. But perhaps plates engraved, or rather finiſhed with the tool, particularly with reſpect to the outline, would be better accommodated in ſome

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of theſe caſes, than thoſe prepared only by ſcraping. In relation to plants, it were much to be wiſhed this method were cultivated; as they might with the ſame, or leſs expence, be better depicted in this manner than by the waſhing prints, as is now ſo much the practice. Two ſets of coloured repreſentations, one of the ſyſtem of medicinal plants, and the other of the indigenous, done in ſmall, ſo that by putting a number in a plate, the price may be rendered moderate, are much wanted for common uſe; and might be eaſily done in this way, as the neatneſs of the execution would not be ſo material as the juſtneſs and accuracy of the deſign, ſo far as relates to the botanical truth and propriety. It is to be feared, however, that as this art has been totally neglected, as to any attempts that have had the probability of being effectual, ever ſince the death of Mr. Le Blon, it will remain ſo ſtill, unleſs revived by the patronage of ſome great perſon or ſociety, who may conveniently bear that expence which artiſts on their own account, whether with reſpect to their time or money, cannot prudently engage in.

Mr. Cochin remarks, at the end of an account he has given of Mr. Le Blon's manner, that though this ingenious artiſt confined his method principally to the uſe of three colours, yet ſhould this invention be again taken up and cultivated, there would be more probability of ſucceſs in uſing a greater

greater variety, and that ſeveral different kinds might be printed by one plate, provided they were laid on in their reſpectively proper places by printing balls, which ſhould be uſed for that colour only. His hint might be however very greatly improved by the further aſſiſtance of ſtencils accommodated to the plates, for the laying on the colours in the proper parts.

What he obſerves would be more particulary true with reſpect to pictures of plants; for in that caſe, not being confined to tranſparent pigments, which have not force enough for the vivid colours of flowers, vermilion, King's yellow, and others of a ſtrong body might be uſed, and with much leſs pains than by working on Mr. Le Blon's principle, where the ſtudy required in making the plan of colouring, and the care and nicety demanded in the execution of it, more than countervail the trouble or expence of an additional plate or two.

CHAP.

CHAP. VI.

Of the method of printing copper-plates.

SECTION I.

Of the inſtruments neceſſary for printing copper-plates.

THE inſtruments and utenſils employed in printing copper-plates are a rolling-preſs, with all its appurtenances; a printing ball for ſpreading the ink on the plate; a leſſer ball for cleaning the plate after the impreſſion is over; a pot with a cover for boiling the ink; an ink veſſel for containing it during the time of printing; a fire pan and grate for heating the plates; blankets for laying over and under the plates on the table of the preſs; a piece of broad cloth for laying over the plate; and a knife for cleaning the printing ball.

The rolling-preſs is the principal, and indeed the only very important machine or inſtrument employed in printing copper-plates. But as the giving a detail deſcription of it, ſuch as would be ſufficient to enable a workman to fabricate one, would take conſiderable room in this volume, without any equivalent advantage,

tage, I ſhall wave it; having nothing to offer with reſpect to the improvement of the conſtruction, and the common kind being at preſent to be procured of thoſe whoſe proper buſineſs it is to make them.

The printing ball is only a piece of white linen formed into a ball by rolling it together as for a bandage, but much more tightly, for the harder it is the better. It ſhould be formed into a conical ſhape, like the figure of a painter's muller for grinding colours; and then rendered compact and ſecure from unfolding, by means of ſtrong thread ſeveral times doubled, and paſſed through it in many different places, by a kind of awl; and at the ſame time faſtened by ſewing, ſo as to reduce it to the ſize of three inches diameter, and of five or ſix inches in height, or thereabouts. It muſt afterwards be pared flat at the bottom, by cutting it evenly with a very ſharp knife; and the other end muſt be faſhioned by ſewing into the figure of a half ball, that it may bear the preſſure of the hollow of the hand in graſping it, to ink ſteadily the plate with the more convenience. This ball ſhould be made of fine ſoft linen half worn.

A leſſer ball is alſo neceſſary for oiling and rubbing the plates after the impreſſion is over. It ſhould be made of ſerge rolled up, and faſtened together, in the ſame manner and figure as the printing ball.

The pot for boiling the ink ſhould be of iron, and proportioned in its ſize to the quantity of ink

ink required to be made. It ſhould be, however, at leaſt a third bigger than will contain what may at any time be put into it. It may be in the form of thoſe uſed for culinary purpoſes, but muſt have a cover which ſhould be thick, and fit the top of the pot ſo as to cloſe it very exactly.

The veſſel for containing the ink during the printing is a kind of ſquare trough, of which three ſides are raiſed high, but that in front made low; the real hollow or containing part being ſhallow, and formed in the front part, by raiſing the bottom, as it were; which raiſed part of the bottom is brought forwards, ſo as to make a ſort of border or rim, on which the printing ball is laid, when it is not immediately in uſe.

The fire-pan ſhould be of iron, and made bigger than the largeſt plate, for which there may be occaſion to uſe it. The depth muſt be in ſome proportion to the diameter; but need not be much greater than will keep the plate, when laid over it, three or four inches above the coals. There muſt be a grate fitted to it of a ſquare form, and ſupported by four legs, the dimenſions of which muſt be ſuch as will admit the pan to be put under it. Betwixt the legs and this grate the pan may be faſtened by rings and hooks, ſo as to hang in its proper ſituation under the grate, but to be removed at pleaſure. The uſe of this grate is to bear the plates when laid over the fire in the pan, and to give air to the coals, to prevent their extinguiſhing.

A trough

A trough, or tray of copper, muſt likewiſe be had for dipping the paper. It ſhould be of a long ſquare form, and as big as the paper called the large eagle, or at leaſt as broad, if a little leſs in length, and ought to have rims round it of the height of eight or nine inches. Along with this ſhould be two ſtrong boards latticed behind, of the ſize of the paper before mentioned; one of which ſhould be latticed on the back, in order to give room for the fingers to paſs under it, when there may be occaſion to remove it from place to place.

A knife muſt alſo be had for cleaning the printing balls, and the other utenſils, when fouled with the ink; the form may moſt conveniently be the ſame with that of the pallet-knives of painters, only it ſhould be large and ſtrong.

Cloths muſt alſo be provided for laying over the plates when put within the preſs; they ſhould be of woollen cloth well milled, but not ſtiffened. When they are applied to this uſe they are called blankets; and indeed the kind of flannel called ſwanſkin is commonly uſed here. In France the printers, who are particularly curious, have ſome of fine ſerge, with both ſides wrought in the manner of the wrong ſide; of which they put one next the plate, and then lay two or three others of the common kind over it. They ſhould be had of different ſizes, according to the plates and paper there may be occaſion to print with; and, as in conſequence of paſſing

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under the weight of the roller, they may be rendered too hard or too ſoft; care ought to be taken to ſpread them in the evenings and mornings before they be uſed, and to twiſt and ruffle them, in order to render them ſupple. Several ſets ſhould be provided to admit of their being waſhed when they are too hard or loaded with the gum, which the paper imparts to them in the printing as they paſs together under the roller. Beſides theſe ſofter kinds of cloth, called blankets, it is practiſed here to have ſome of broad cloth for laying immediately over the plate.

Linen cloths ſhould alſo be procured for ſeveral purpoſes; for the greateſt part of which ſuch as are worn out is moſt proper. This kind ſhould be had in plenty, becauſe ſome ſhould be appropriated to each uſe.

SECTION II.

Of the printing ink.

HAVING, before, in the part where inks are treated of, given the beſt recipe for preparing this kind it is needleſs to repeat it here, as it may be found in p. 16; but it may not be amiſs to obſerve, that nothing can be of more conſequence to this kind of printing than the good or bad qualities of the ink: for, beſides the rendering the prints of little value

value when the consistence or colour of the ink is bad, the plates themselves frequently suffer extremely from a slight use by the corrosion of bad ink. It is, therefore, most expedient for all who are concerned in this kind, in the case of works of any value, to prepare the ink themselves, which they may be certain of doing to perfection, by following the directions of the recipe above referred to, and can meet with no difficulty, except in procuring the best German black, which may be had either from Frankfort, where it is made, or from Holland or Paris.

SECTION III.

Of the manner of printing copper-plates.

THE press, with all the other utensils, being prepared, the table must be put into it and adjusted, which is done by thrusting the thinnest side of it betwixt the rollers, and, at the same time, turning the press with the other till the rollers come over it; and if the press have not been used before, since the parts of it were put together, it is requisite to try if the two rollers close properly on its surface above and below. The manner of this trial is to draw with Spanish white (or chalk, prepared by washing) a right line along the

length of the table of the preſs, and another broadways. If the roller be paſſed over the table, and the line appear marked perfectly on it, without any break or faintneſs in any particular part by the turning the preſs, it may be concluded all is right; but, if the contrary be found, the preſs muſt be adjuſted by adding, on the ſinking ſide, more of the cartoons which are put into the openings of the cheek of the preſs till the rollers be brought to a due level. The printer muſt then place himſelf, ſtanding with his face towards the preſs, having the greateſt part of the table brought forwards at his ſide, and put, in the moſt even manner, one of the blankets on the table; and afterwards two or three others upon it, in ſuch manner that the uppermoſt of them may ſpread beyond that under it, and that beyond the next; and ſo of the reſt, when there are more. This is proper, in order that the roller may take more eaſily on each of them, when the croſs is turned; for it is obvious, that being diſpoſed thus by gradation, the upper roller, in being drawn over the table, will riſe more eaſily upon the blankets in this ſtate. When the meaſure of an inch is thus gained in the ſize of the uppermoſt cloth, the printer muſt turn them evenly all together upſide down on the roller; and then take a ſheet of white paper, of the ſize of thoſe that are to be printed, and ſpread it in the middle of the table, and gum it down; the deſign of which is to mark out the place where the plate ſhould lie, that he may the more

more readily put it each time an impreſſion is to be taken from it in its proper ſituation.

The preſs is then properly prepared to receive the plates; but before we proceed to the explanation of the particular manner of paſſing the plate and paper which is to be imprinted, through the rollers, it is proper to deſcribe the preparation of both to undergo this operation, the paper by being moiſtened, and the plate by being duly charged with the printing ink.

In order to moiſten the paper, five or ſix ſheets muſt be taken, and being held extended with both the hands, they muſt be dipt into the copper trough, or tray, before mentioned, p. 193, which muſt be half filled with clean water; and this dipping muſt be inſtantly repeated two or three times, according as the ſtrength of the paper, or the quantity of gum in it may make neceſſary; but the ſheets muſt be kept exactly even and free from all folds. They muſt be then put, in the ſame even ſtate, on one of the pieces of wood above directed to be prepared for this purpoſe; and the ſame muſt be done of the remainder, laying parcel after parcel one upon the other, till the whole be dipt. The other piece of wood muſt be then laid upon them, with the even ſide downwards, if either be latticed, ſo that the paper will be incloſed betwixt the two boards; and over the uppermoſt board a conſiderable weight ſhould be put, that the water may be forced into all parts of the paper alike, and the ſuperfluous quantity preſſed out. They

muſt be left thus loaded till there be occaſion to take them away to print them; and it ſhould be ſo calculated that a night's time ſhould be afforded for them to lie in this condition before they be printed, in order that the water may drain properly from them; but if they be not uſed the next day, they ſhould be dipt over again for the conſumption of the day after, as they grow too dry if continued longer in this ſtate than twenty-four hours. Care ſhould always be taken to adapt the dipping to the ſtrength and gummineſs of the paper: and it ſhould be obſerved, that ſuch as is deſigned to be imprinted with plates done by the graver, ſhould be kept longer after dipping than any other. It is ſometimes neceſſary to allum the paper, which may be performed by melting the due proportion of allum in hot water, and adding it to that in which the paper is dipt, ſo long before, as to give time for the mixture to grow cold before it be uſed.

The above is the direction given by Mr. Cochin; but, there will rarely be found any paper that can be brought to a ſtate for printing in ſo ſhort a time; for the gum in paper of ſuch thickneſs, as is uſed for copper plates, prevents the water from diffuſing itſelf, and rendering the paper equally moiſt and ſoft in every part, as will be eaſily ſeen on holding the paper up betwixt the eye and any light by the opake ſpots. The beſt practice is, therefore, after the dipping, to ſheet the paper; that is, to lay it ſtraight on the boards ſheet by

ſheet,

ſheet, and then to put on the upper boards, as above, and ſuffer it to lie about three days. It muſt then be paſſed under the roller of the preſs, by ſeparate parcels, as many ſheets being in each parcel as the preſs will admit. After this it muſt be again ſheeted, and put on the boards, and there left at reſt for a fortnight, or three weeks, *to rot*, as is called by the printers, till the whole be intirely free from ſpots, and equally tranſparent. The preciſe time for rotting varies greatly, according to the thickneſs and gummineſs of the paper; and cannot therefore, be reduced to any rule; but it muſt be judged of by examining the paper from time to time, which will be always fit when the whole is equally tranſparent and free from ſpots. If, as it ſometimes happens the paper be found to be mildewed, it muſt be hung upon cords, each ſheet ſingle, till it be near dry, and then muſt be dipt and preſſed again when it is to be uſed; but a ſecond rotting is not neceſſary. The dipping and preſſing muſt be practiſed in the ſame manner, if at any time the paper grows too dry before it can be printed off.

The manner of inking the plate is thus: Being engraved, filed, cleanſed, and every way ready for printing, it muſt be laid on the grate deſcribed p. 192, with its back towards the burning coals, which muſt be previouſly put into the pan intended to contain them, and deſcribed alſo p. 192. But the coals ſhould be previouſly covered with aſhes, to make

them burn more equally, and laſt the longer time. Having ſuffered the plate to be a little heated, it muſt be taken in the left hand by one of the corners, and, being held ſteadily and flat over the grate, and the printing ball being taken in the right, and dipt in the ink, the plate muſt be rubbed all over with it on the engraved ſide, which will of courſe be uppermoſt; and by gliding and preſſing the ball, and beating ſtrongly with it in every direction, the ink muſt be driven into all the minuteſt hollows of the graving in every part of the plate. But if the plate be new and large, or where there are ſtrokes of the graver long and deep, as in the ſquare or border round the edge, the ball muſt be again carefully paſſed over theſe ſtrokes, and ink even put there with the finger, by running it along the deep lines, to fill them with, and make them hold it. This is, nevertheleſs, only neceſſary for the firſt print; for afterwards there will remain enough always in the lines, to furniſh, by means of the ſupply given in the common manner of inking the plate, a ſufficient quantity for thoſe that ſucceed.

When the printing ball is new, four or five times as much ink ſhould be taken as there is occaſion for, when one uſed before is employed; becauſe, after being well ſatiated with the ink, it requires only to have the ſurface covered, not imbibing any more. It muſt be remembered, likewiſe, to put the printing ball always on the plate where it ought to be; that

that is, on the rim or raiſed bottom in the front of the ink veſſel, that it may get no dirt or ſand, which would ſcratch the plate; and it can ſcarcely be kept from ſuch foulneſs if it be put at random in other places. When it happens, that after having printed much, or having diſcontinued for ſome time, the ball becomes hard at the bottom, on account of the ink which ſticks there, and gains a tenacity in drying, a thin ſlice of it muſt be taken off with a very ſharp knife, and the ball muſt be charged well with ink before it be uſed again.

The ink having been thus made to enter thoroughly the lines and ſtrokes graven on the plate, and the printing ball being put in its proper place on the border of the ink veſſel, one of the cloths or clouts made of old linen muſt be taken off, and the body of the printing ink which lies on the plate, as well as that which ſticks to the back and ſides of it, muſt be gently wiped off; then the firſt clout being put away, but left upon the grate, or ſomewhere at hand, the plate ſhould be carried to the table and laid down on it, which ought to be placed for that purpoſe at the head of the grate; and the hand being paſſed ſlowly, but hardly over the plate, all the redundant ink, that is, ſuch as is not actually lodged in the ſtrokes or hatches of the gravings, ſhould be taken off by degrees, obſerving to wipe off the ink, from time to time, from the hand that is thus employed, with a clean clout,

clout, which muſt be held in the other hand, with which alſo the plate muſt be ſteadily fixed, that it may not ſlide and get looſe in going over it with the flat part of the other hand to clean it; which muſt be done, as is above intimated, by running the hand along it, ſometimes lengthways, ſometimes breadthways, and alſo diagonally, and in all other directions, that there may not remain the leaſt ink but in the ſtrokes where it is neceſſary. When it appears that there is not any more ink or ſpots in any part of the ſurface of the plate, where there is no engraving, the border and edge muſt be alſo wiped, and even the table where the plate has been laid to be cleanſed; and the plate muſt be then put again upon the grate, and the hand being cleared from the ink, muſt be rubbed with Spaniſh white; after which, the plate being moderately heated, muſt be carried back to the table, and the whitened hand paſſed ſlightly over it, which is very ſerviceable in the caſe of plates engraven in large portraits, and in that of other works which require more care and attention than ordinary; but it is not abſolutely requiſite, and therefore may be diſpenſed with on common occaſions, where diſpatch is the greateſt advantage that can be had in the manner.

Great care muſt be taken after this not to touch the plate in the places where it is engraved, for fear of its contracting any dirt; and it is proper to intimate here, that things muſt

muſt be managed in ſuch manner as to avoid wiping the plate with ſweaty hands; for rather than that ſhould be, it is better to wipe it with a rag, as many printers do at preſent, in the caſe of pieces of architecture and other works that do not require ſo much nicety in the treatment as portraits. When this is done, however, after having left the firſt rag on the grate, they take another cleaner, which ſhould lie ready on the table, and wipe it with this alſo; and after the plate appears to be clean, having wiped, as above directed, the border, edges, and under ſide, they take a third linen rag, moiſtened with clean water, and paſs it over the whole plate, to finiſh the cleaning all that part of it which ought to leave the print white. It may be conceived from what has been ſaid, that it is not neceſſary the firſt rag ſhould be of fine linen nor clean, as being uſed only to take off the ink groſsly, and may ſerve therefore for a long time, provided the ink does not dry upon and harden it; and with reſpect to the ſecond clout which is uſed for this purpoſe, when it becomes moderately dirty, it ſhould be applied to the firſt uſe, and another taken in its place; but the laſt ſhould be always fine, and as ſoon as it appears ſoiled or dirty, it ſhould be applied to the purpoſe of the ſecond, and whenever a freſh one is taken, it ſhould be wet with a ſpunge as thoſe preceding, the ſpunge being kept wet in a pot with water ready for this uſe. Some printers make uſe
of

of urine inftead of water; but that is very detrimental to the plates, and fullies the white of the prints by the number of fpots and little holes which it makes in the copper, on which account it ought to be abfolutely rejected. The printer, befides thefe clouts, fhould have a towel lying before him on the table, and likewife a little white linen cloth faftened to his belt to wipe his fingers before he takes hold of the fheets of paper, in order to their being printed, as well likewife as when he is to take them away again after they are printed.

Every thing being thus ready, the printer muft take the plate by the back and fides, and lay it carefully on the paper fixt on the table, as above-mentioned, to mark the proper place; and having wiped his fingers on the towel, which is hung near at hand for that purpofe, he muft take one of the fheets of paper prepared by moiftening and rotting, according to the manner above directed; the whole quantity of which ought now to be placed on the head of the prefs, and put it gently and evenly upon the plate, fo as to cover it exactly; and upon that he muft lay a fheet of blotting paper wet with a fpunge dipt in water, and over them the blankets that were hung on the roller; or, according to the better practice which now prevails here, a piece of broad cloth as above-mentioned. He muft then turn the crofs of the prefs equally and flowly, till the whole has paffed to the other fide of the prefs;

preſs; but if the plate be not of an equal thickneſs in every part, it is neceſſary to put pieces of cartoon, or other thick paper, betwixt it and the table, ſo as to bring it to a proper level.

When the plate has thus paſſed to the further ſide, ſo that the roller no longer bears upon it, but only on the further edge of the blanket, the printer muſt again turn the croſs of the preſs the contrary way, and make the table and the plate re-paſs back to their former place. This is always advantageous in works that are fine and of importance, becauſe it ſecures the certainty of a better impreſſion. But for diſpatch, it is frequently practiſed to paſs the plate only once under the roller, and not to return the table to its place, but by paſſing a freſh print under the roller. In order to which the printer goes to the other ſide of the preſs, when he takes the plate out of the blankets. This is not ſafe, nevertheleſs, where impreſſions require the greateſt accuracy; but in the caſe of maps or other coarſer engravings it may be admitted, and ſaves ſome time and labour. Which ever method be purſued, the ſubſequent proceedings muſt however be thus: The printer, when the impreſſion is in this manner made, by paſſing the plate under the roller, either twice or once, muſt raiſe the blankets, and turn them over the roller as they were at firſt; and then take off the broad cloth or blotting paper mentioned above to be laid over the paper on which the impreſ-

ſion is now made. He muſt then carry it to the grate, and ſuffer it to grow ſo warm, that the paper may be ſenſibly drier than when the plate was taken out of the blankets.

After this, having wiped his fingers on the linen cloth which hangs to his belt, he muſt take up by the two corners the ſheet of paper which is on the plate, for fear the black of the ink may ſmear the paper; and having laid it down by him, he muſt again carry the plate to the grate to be inked as before, and proceeding the ſame, as to the reſt of the operation, as he did with the other.

It is proper to mention, that for the convenience of the printer, there ſhould be near each ſide of the preſs, or in ſome commodious places cloſe at hand, two boards or planks, put upon ſomething that will raiſe them breaſt high, and covered with a ſheet of grey paper, upon which the prints may be laid evenly one upon another as he paſſes them through the preſs, (or *pulls them off*, to uſe the printer's phraſe). The reaſon of having two of them is, that when he ſtands on one ſide of the preſs, he may have one there, and when at the taking off the next print he removes to the other, he may ſtill find another equally near him, the moiſtened paper to be printed being put on the head of the preſs as was before intimated.

When the printer has done his work, he hangs on cords, that are clean and drawn tight, all the prints he has taken off; which, if it can-

cannot be conveniently performed the ſame evening, ſhould be done the next morning; and when they are thus hung, they muſt be left till both the moiſture of the paper and that of the printing ink be dried away. After which they muſt be taken down, and putting them together dozen by dozen into the preſs, to take away the creaſing of the cord, he leaves them there a day or two; when, being carefully laid one upon another, they ſhould be put into ſome box or other proper repoſitory, which will complete the drying, and bring the ink to its proper colour.

In the mean time, after having taken off as many prints as are thought neceſſary from the plate, the printer takes likewiſe a little ball, which is formed by rolling together a piece of ſome of the old blankets, or any other woollen ſtuff, in the manner of the printing ball, or any other commodious form; and, having oiled it well, he heats the plate a little upon the grate, and then rubs it ſtrongly with this oiled ball. By this means the ink in the ſtrokes and hatches is rendered thinner, ſo as to be afterwards wiped out by rubbing with a clean linen clout; but to be certain that the leaſt ink may not be left behind, they take off a proof on a ſheet of blotting paper moiſtened with a ſpunge.

This blotting paper, being afterwards well dried, they wrap up the plate in it to preſerve it from the duſt, putting one of the prints upon it in order to diſtinguiſh it, and they

they lock it up in ſome proper place, where it may be well ſecured from contracting the leaſt moiſture.

If the duly cleaning the plate in this manner ſhould be ſo neglected that the ink ſhould dry in the ſtrokes or hatches, which would make the next proofs taken from it appear weak, and as if the plate had been worn out, this ink muſt then be got out by the following means.

When there are ſeveral to be ſo cleaned at the ſame time, then take the copper veſſel or trough, which ſerves for dipping the paper, and ſet it upon two tall dogs, or any other thing to ſupport it, and make a fire under it; putting it into all the plates, with a quantity of wood-aſhes ſifted, ſome pot-aſhes, and a conſiderable proportion of water. They then ſuffer the lye, made by the water and aſhes, to boil ſeveral hours with the plates in it, and then they take them out and waſh them immediately in another veſſel full of clean cold water, to free them from all the aſhes, and afterwards ſet them to drain, being reared obliquely againſt a wall, or other ſupport. They then wipe them very carefully to prevent any aſhes or ſand remaining, which might be liable to ſcratch them. When there is one alone to be cleaned, and that is of a moderately large ſize, they place it on the grate with the back downwards, and cover all the plate with wood-aſhes, which muſt lie upon it the thickneſs of a finger, being moiſtened and

dipt

dipt in water before they be uſed for this purpoſe. They then make a clear and ſtrong fire under the grate, to heat the plate, and make the moiſture in the aſhes boil upon it; and, after ſome time, the lye formed by the moiſture and aſhes will attract and diſſolve the ink, in the ſtrokes of the engraving, ſo as to render it very eaſy to be cleaned, by waſhing it copiouſly with water poured upon it.

This is the method adviſed by Mr. Cochin, but the uſe of the aſhes is not ſo commodious as the adding the ſalt which they contain, and which is indeed the only efficacious part, the earth of the aſhes not being capable of producing any effect but that of ſcratching the plate. The beſt method, therefore, is to uſe a proper quantity of the pearl-aſhes, which is nothing more than the ſalt extracted from wood-aſhes; and which, being diſſolved in warm water, and then purified, either by filtering or decanting off the clear part, after it has ſtood ſome time to ſettle from the dregs, will anſwer the end much better than uſing the crude aſhes, in which the earth is detrimentally to this purpoſe mixt with the ſalt.

As there is ſometimes occaſion to print on paper which is firſt gilt, a difficulty is apt to ariſe in making the printing ink take to the gold. In this caſe, the remedy is to mix with a portion of the oil of the ſize of an egg, half a ſpoonful of ox-gall, mixt and incorporated with a little vinegar and ſalt; but care muſt be taken not to make this compoſition more than

 two

two or three hours before it be wanted; because, if it be kept much longer, it will of course be ſpoilt.

When there is occaſion to print with different colours, the ſame method may be obſerved in the caſe of brown, or ſuch other colours as derive no advantage from brightneſs, in preparing the ink as for common prints. But where purer colours are in queſtion, fat oil, mixed with old nut oil ſhould be uſed inſtead of theſe prepared by heat; and if gum-maſtic or ſandarac be melted in the nut oil employed for this purpoſe, uſing only ſuch a heat as cannot brown the oil, it will be found of advantage.

It may not be unneceſſary to explain here what is meant by proofs and counterproofs. By a proof is underſtood, the firſt, ſecond, and third ſheets that are printed off from a new plate; or one that is begun to be uſed again, after having been laid by. The counterproof is made in the following manner. A proof, freſh pulled off, is laid on the plate with its back downwards; and upon it is laid a blank ſheet of the paper ready wet for printing; and over this a ſheet of blotting paper is put, and the blankets turned over the whole. The croſs of the preſs is then turned, and the plate and proof paſſed under the roller. The ſheet of paper being afterwards taken off, the proof will be found to have calked an impreſſion of the print upon it; and this is called the counterproof; which is commonly taken

taken with deſign to be better able to ſee how to correct and re-touch the plate; becauſe the impreſſion in it is turned the ſame way as the drawing and the plate, and it is always more tender, that is to ſay, leſs black than the proof, which conſequently makes it more eaſy to be worked upon in re-touching and correcting the deſign.

SECTION IV.

Of the method of producing waſhed prints much more beautiful than the common.

MR. Cochin obſerves, that conſidering with attention the prints waſhed with ſeveral colours to imitate paintings, it occurred to him that it would be better to do the contrary of what was commonly done in the manner of ſuch waſhing; for inſtead of applying the colours upon the impreſſion, he imagined it would be much more advantageous to print upon them, which he adviſes to be performed in this manner.

Suppoſing, for example, there was a plate perfectly engraved with a figure which it was deſired to clothe with two or three colours; as the hat grey, the hair browniſh, the cloak red, the coat of ſome other colour, and the ſtockings ſtill different. Another plate of copper ſhould be then procured thoroughly well

poliſhed, and then filed and fitted exactly to the ſize of the firſt, in ſuch manner that, being put together, all the corners and edges may exactly coincide with each other. Having varniſhed this ungraved plate with the white varniſh, as is directed p. 100, let a proof freſh pulled off from the engraved plate be laid upon the varniſhed plate, exactly in the place where the engraven plate has given the impreſſion. Spread then two blankets upon the table of the preſs, and lay the varniſhed plate upon them with the proof lying on it; and having covered them with two or three other blankets, paſs them under the roller of the preſs. When the blankets and proof are taken off the plate, the white varniſh will be found to be printed with the ſame impreſſion that was on the proof in the manner of a counterproof; and the outlines of the hat, hair, cloak, &c. muſt be traced with a very fine needle, and the plate then corroded gently. After this the varniſh ſhould be taken off from the plate, and ſome proofs ſhould be taken from it on ſtrong paper allumed, or upon cartoon very thin and well beaten, which ſhould be previouſly moiſtened by laying in a damp cellar for a night or two, or rather by putting it among the paper moiſtened in order to be printed. The proofs being made, and the cartoons or paper on which they were printed being dry, the part incloſed in the outline of the cloak ſhould be coloured with a red ground, that within thoſe of the head

head with a brown ground of biſtre, and the ſame of the reſt.

This being done, the ſheet thus coloured muſt be put into the cellar, to make it moiſt; and then having ſpread ſome of the blankets on the table of the preſs, the coloured ſheet muſt be laid on them, with the blank ſide downwards. After having inked all the firſt plate that has the entire engraving upon it, in the manner as for printing at other times, it muſt be put upon this leaf with the engraved ſide downwards, ſo that the parts, of which the outline is marked on the ſheet, may coincide exactly with thoſe correſpondent to them in the plate; and then two or three blankets being laid over them, the whole muſt be paſſed through the rollers. After which, the ſheet, being uncovered, will be found printed upon the colours in a manner that renders the effect much more beautiful than that of thoſe printed and coloured upon the printing, as in the common way.

There are two obſervations I ſhall take the liberty of adding to theſe ingenious directions given by Mr. Cochin. The one is, that, inſtead of the laying the ſheets of paper to be printed in a damp cellar, or within other ſheets dipt for printing in the common method, for both which opportunities may be frequently wanting, they may be much more commodiouſly moiſtened at all times by the ſteam of a kettle of boiling water in this

way. The kettle being covered, and the ſteam only ſuffered to paſs through a ſpout or pipe, the paper, by being held at a diſtance from ſuch ſpout or pipe, may be made wet very quickly, in a greater or leſs degree, as there ſhall appear occaſion. The other obſervation is, that when the ink is laid on the colours by printing upon them, there is no general reaſon for uſing tranſparent colours, as is the caſe in waſhing the prints; but vermilion, verditer, and others may be uſed, though of the ſtrongeſt body, which would be a great advantage, in caſe plants and flowers, the ſtrength and variety of whoſe colours demand all the ſcope imaginable, were to be treated in this manner, as they might be in a way that would render the prints much more pleaſing and juſt than the uſual method of waſhing.

SECTION V.

Of the method of printing in chiaro obſcuro.

THE printing in *chiaro obſcuro*, is the producing a ſtrong effect of relief, attended with a juſt and natural gradation of the lights and ſhades, grounded with brown, with white and black, by printing on paper; by which means a greater latitude, as

as well as a closer union of the lights and shades may be obtained, than by printing with black on the paper in a simple state.

This invention was discovered in Italy, in the sixteenth century, by Hugo da Carpi, and appeared to Mr. Le Bosse, to whose hands pieces done in this way came some time afterwards, not only so great but valuable a novelty, that he sought out the method of performing it, and afterwards taught it in this manner:

Two copper-plates must be provided of equal size, and exactly fitted one to the other. On one of them must be engraved entirely the design proposed, and then the prints must be taken off from it with printing ink, on sheets of grey paper, in the manner just above directed in the case of washed prints. The other plate must then be varnished likewise in the manner of that for the washed prints, and the varnished side being laid upon the sheet printed by the first plate, they must be passed under the roller, when the print will have made a counterproof on the varnish of the plate; after which the lights must be graved on the plate, and corroded very deeply by *aqua fortis*. The same may otherwise be done with the graver, and even with more ease by those who can use it well.

In proceeding to execute this method of printing, a difficulty always occurs of finding such paper and oil as will admit of being used

for printing, without the oil rendering the paper yellow or brown. The beſt method to get over this, is to uſe very white nut oil drawn without fire, and to put it into two leaden veſſels, and ſet in the ſun till it grow thick in the proportion of the weak oil of which notice will be taken below, for that which is intended to form this thick oil muſt be continued in the ſun a conſiderable time. Flake white muſt then be taken, which, if it be not before prepared, muſt be ground and waſhed over till it be extremely fine, and then being dry, it muſt be ground with the weak oil, of which no more ſhould be uſed than the leaſt quantity required for grinding the flake; after this the thicker oil muſt be added in the manner before directed for the printing ink, p. 16. Then having taken an impreſſion with black printing ink, or any other colour from the firſt plate that is entirely engraved, or coarſe grey paper, it muſt be ſuffered to dry ten or twelve days; when theſe prints having been wet, another impreſſion muſt be made upon them by the plate, on which the lights are engraven, charged with the white flake and oil in the uſual manner of printing; taking care that the correſpondent parts of the plate, and the impreſſion already made, may be adapted exactly. By this means the printing in *chiaro obſcuro* is perfectly performed.

CHAP.

CHAP. VII.

Of engraving wood with a view to printing.

Engraving in wood, with a view to printing, is performed in an oppoſite manner to that on copper-plates, for in the latter, the lines which are to produce the expreſſion or delineation on the paper are ſunk or hollowed; whereas in this kind they are projecting or raiſed, as in the caſe of letter printing.

The inſtruments employed for this kind of engraving are, with reſpect to the calking or drawing the deſign, the ſame with thoſe uſed for copper-plates, and on other occaſions; thoſe employed for the cutting and forming the figure in the wood itſelf, are knives, chizzels, and gouges.

The knives may be formed like penknives, but ſhould round greatly towards the point, and ſome ſhould be had with very ſmall and narrow blades.

The chizzels ſhould be of very different ſizes, and made with one ſide flat, but of very thin ſubſtance, that ſmaller or larger pieces may be taken off with the greater linear exactneſs.

The gouges, or round chizzels, ſhould likewiſe be of different ſizes, and ſections of different circles; they may be made in the ſame

ſame form with thoſe commonly uſed for carving ornaments in wood.

Being prepared with theſe inſtruments, the choice of the wood is the next principal care in order to ſucceſs in this kind of engraving, which can never be poſſibly well performed but on the proper kind. Beech, pear-tree, and box, are all uſed for this purpoſe; but the laſt is moſt ſuitable, being more compact, and having a leſs grain. Pieces ſhould be choſen which are wholly free from all knots and variation of the texture; and regard ſhould likewiſe be had to their having been ſawed or divided from the body of the tree according to the true line of the grain; for unavoidable cutting croſs the grain renders the raiſed work too weak to bear the additional diſadvantage of being originally impaired, by being ſawed off from the trunk in an oblique direction to the lines. It is proper alſo the wood ſhould be kept a conſiderable time in the plank before it be applied to this purpoſe, otherwiſe, after it is engraved, it may warp before the whole of the impreſſions there may be occaſion to take from it may be worked off; which warping, even in the ſmalleſt degree, would intirely ſpoil it for further uſe. To prevent this, it may not be improper, where there is a proſpect of keeping the wooden print for any length of time, to uſe very thin plank, and cement it down, as is practiſed in fineering, upon thick old plank that is thoroughly ſeaſoned, and the additional

additional weight will in moſt caſes rather be an advantage than an injury. The thickneſs of the plank for engraving, where no other is ſuperadded, ſhould be an inch or upwards; but if it be laid on another, then it need not be more than a fourth of that thickneſs; and the other, added to ſtrengthen it, may be an inch and quarter, or half. But this is to be underſtood only of thoſe intended for very large deſigns; for in leſſer, a proportionable diminution may be made, allowing always, nevertheleſs, ſuch thickneſs as will admit of the cutting without weakening the main ſubſtance, ſo as to hazard the breaking of the print by any ſlight accident. The wood being choſen, and cut into a proper form and ſize, it muſt be planed as even and truly as poſſible, and will be then ready to receive the drawing or calking of the deſign to be engraved. But to render the effect of ſuch drawing or calking more apparent, as well as to prevent the running of the ink, if any be uſed in making the drawing, the following method may be practiſed.

"Take white lead and temper it with "water by grinding. Then ſpread it firſt "thinly on the ſurface by a bruſh pencil, "and afterwards rub it well with a fine linen "rag, while yet wet, and, when it is dry, "bruſh off any looſe or powdery part by "a ſoft pencil."

If the deſign be ſketched on the wood by drawing, it may be done by Indian or common

mon ink, (but the firſt is far preferable) either by a pen or pencil, or by a black-lead pencil, though that ſcarcely marks ſtrongly enough for finer work. But if, which is more common when the deſign is taken from any drawing or print, it is calked on the wood, the means before directed for calking deſigns on copper-plates, or thoſe uſed on other occaſions, may be employed, or figures are ſometimes cut out of prints, (which is to be done by taking away all the white part or blank paper) and cemented on the ſurface of the wood, and in this caſe, gum water only is neceſſary to hold the paper to the wood. There is another method, likewiſe, which is the laying the entire print ſmeared over with gum tragacanth on the wood, and, after it is dry, wetting the paper again with water only, and then rubbing it off, by which means the printing ink will be left on the board.

The deſign being thus ſketched on the wood, by drawing, calking, or cementing a former print, the wood muſt be cut away betwixt the lines of all the ſeveral parts; which muſt be done by the chizzels, gouges, or breadth of the pieces to be taken away. In large figures, where the lines run in a right direction, the chizzels will perform the work with moſt expedition and truth, and where curve lines occur, the gouges muſt be ſubſtituted, the knives being principally to be uſed either for ſmall work, or for repairing larger,

larger, where the chizzels and gouges cannot be applied with ſufficient exactneſs, or have left parts that want re-touching and finiſhing.

The engraving in wood is much more difficult and tedious than that of copper; becauſe, in cutting it and picking out the ſeparated pieces, the grain of the wood, when it is croſſed, renders the remaining parts ſo extremely fragile that they are apt to break and fly out to the deſtruction of the effect. This has occaſioned the uſe of copper-plates to ſuperſede the other, in all caſes, except for very ordinary purpoſes. But, though this is reaſonably done with reſpect to high-finiſhed prints, yet in the repreſentation of plants and flowers, and in deſigns for paper hangings, where the outline only, as is frequently the caſe, is wanted to be printed, and that in a bold full manner, this method will be found cheaper and more effectual than the uſe of copper-plates.

As the accident above-mentioned of the breaking off of part of the raiſed work is liable to happen frequently, even when the greateſt care is taken, it may not be improper to propoſe a remedy for the defect occaſioned by it. This is, to cut out ſo much of the work as is injured in a ſquare piece, going lower than the wood was cut in the engraving, and then to replace the ſquare part ſo cut out by another piece exactly of the ſame form and ſize; which ſhould be fixt in its place by means of iſinglaſs glue; and, after the glue is thoroughly ſet and dry,

dry, planed to an exact level with the projecting parts of the engraved wood, and then engraved over again, the parts of the design or figure to which it corresponds being previously drawn or calked upon it.

The manner of printing with wooden prints is much more expeditious and easy, though the trouble and difficulty of engraving them be much greater than that of copper-plate; because they require only to be dipt in the printing ink, and impressed on the object in the same manner, and with the same apparatus as the letter printing is managed; and for purposes that do not require great correctness, the impression is made by the hand only, a proper handle being fixed to the middle of the print, by which it is first dipt in the ink, spread by means of a brush on a block of proportionable size covered with leather, and then lifted up instantly, and dropt with some little force on the paper, which is to receive the impression.

PART III.

Of the nature and compoſition of glaſs, and the art of counterfeiting gems of every kind.

CHAP. I.

Of glaſs in general.

BY glaſs, as here treated of, is to be underſtood the artificial vitrifications of bodies, made to anſwer ſome uſeful purpoſe, either in domeſtic neceſſaries, or other articles of commerce; and the obſervations and directions given with regard to it, in this treatiſe, are ſuch only as reſpect the improvement of the art of preparing and compounding the kinds applicable to theſe ends in the different manufactures of it; for the more ſpeculative and philoſophic diſquiſitions on its nature are avoided, where they lead to no principles that are capable of being applied to practice. The methods of modelling and forming

forming it into all the variety of veſſels and other figures into which it is wrought, are likewiſe omitted, becauſe they are already, or may be by other means, well known to thoſe who have any concern with them as an employment; or, like all other occupations of artiſans, may be much more eaſily and better learnt by ſuch as are deſirous to be initiated into an operative knowledge of them, from an inſpection of actual works, and trials to imitate what is there to be ſeen done, than they can by the moſt explicit verbal directions.

The manufactured glaſs at preſent in uſe may be divided into three general kinds; white tranſparent glaſs, coloured glaſs, and common green or bottle glaſs. Of the firſt kind, there is a great variety of ſorts, according to the ſeveral purpoſes intended to be ſerved by it, either for making domeſtic utenſils, or lights for incloſed places; and of the ſecond there is likewiſe a ſtill greater multiplicity of ſpecies, differing in their colour, or other properties, according to the occaſions for which they are wanted; but of the laſt there is no diſtinguiſhed difference of ſort, except what the accidental manner of preparation and management, practiſed according to the ſkill or art of particular directors of manufactories, may occaſion.

In order, however, to ſpeak more intelligibly of the nature of the manufactured glaſs,

glaſs to be here treated of, it is proper to give ſome diſtinct notion of vitrification in general. But I ſhall not endeavour to puſh the matter to thoſe almoſt metaphyſical lengths to which Becher, Stahl, and others, have endeavoured to carry it, even far beyond the concluſions which can be ſupported by inductions from ſufficient experiments. Vitrification then (according to the more general and obvious notions of its nature) is a change which may be wrought in moſt kinds of fixt bodies, or rather in all, under ſome circumſtances, by the means of heat, applied in various degrees, according to the various nature of the bodies; from which change they become fluid, and continue ſo while kept in the ſame, or any greater degree of heat, and, when become cold, acquire tranſparency, fragility, a great but not abſolute degree of inflexibility, a total want of malleability, and inſolubility in water. All theſe qualities are inſeparably attendant on perfect vitrification; though there may be many preparations of artificial glaſs, even among thoſe that are in common uſe, in which ſome of them are wanting. But this is, nevertheleſs, only where the vitrification is immature, or where there is an admixture of other bodies with the vitrified matter, as in the caſe of the opake white glaſs, in which the matter giving the milky colour is in an unvitrified ſtate, and conſequently deſtroys the tranſparency,

rency; or, in the compofitions where too great a proportion of falts is ufed, when the glafs produced will be foluble in water, though perfect with refpect to all the other qualities. In both thefe cafes there is the prefence of an heterogeneous body, befides the proper glafs, and therefore, if the whole mafs be confidered as in a vitrific ftate, it muft be deemed to be in an imperfect one, though the compofition, in the inftance of the white glafs, be adapted by this very circumftance to the œconomical purpofe for which it is intended. The fame principal will be verified, on a due examination, in all the other forts of manufactured glafs, as well as in accidental commixtures where the appearances of the glafs difagree with the fyftem of qualities required, in the above given definition, to the perfect conftitution.

From the nature of vitrification, it therefore appears that all fixed bodies are capable of being the materials of perfect glafs under fome circumftances. But as the means of vitrification are limited with regard to the manufactured glafs, fuch bodies only are proper to become the ingredients of the perfect kinds of it as are eafily to be procured in due quantity, and admit of being vitrified by the heat of a furnace either alone or by their commixture with others, which may promote this change in them; and in the cafe of the imperfect forts, fuch as that above mentioned, bodies that are not capable of being vitrified

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by the means there employed, are alſo taken in as materials, where they are required to give the particular properties wanted in each peculiar ſort. The principal ſubſtances therefore that are choſen for the compoſition of manufactured glaſs are ſand, flints, and other foſſile bodies of a ſtony and earthy texture; metals and ſemi-metals of all kinds previouſly prepared by calcination, or other operations; arſenic and zaffer which are prepared parts of a foſſile, and all ſorts of a fixt kind.

Among theſe ſubſtances there are ſome which are ſtrongly reluctant to the vitreous fuſion, and could ſcarcely alone be ever converted to glaſs, at leaſt not by the heat of any furnaces, and yet are ſuch as are moſt capable of giving firmneſs and tenacity to that in which they are admitted, as alſo of being more copiouſly provided at a ſmall expence. There are others, on the contrary, that vitrify in a much leſs heat than that commonly employed in the working of glaſs, and have likewiſe this attendant property along with their own proneneſs to vitreous fuſion, that they accelerate and produce it in many of thoſe that are otherwiſe more repugnant to it; and cauſe them, by their commixture, to vitrify in a greatly leſs degree of heat than they otherwiſe would. This property of promoting vitrification is called technically *fluxing* the bodies on which they ſo act, and on the proper application of this principle to practices lies the main ſtreſs of ſkill in the art of com-

pounding glaſs, as the ſavings in the original coſt of the ingredients in time and in fuel, as well as the qualities of the glaſs produced, depend chiefly on the thorough intelligence, in this view, of the nature of the bodies proper to become ingredients of it. The next important relation in which bodies ſtand with reſpect to the compoſition of glaſs, is the effect they may have on its colour by their admixture; in order to deſtroy all kinds of which in ſome caſes, and to produce them in others, ingredients are frequently added that are not otherwiſe neceſſary, as being no way ſubſervient to the general view. This conſtitutes therefore the other great object of ſkill in the art of making glaſs; for the knowing properly how to take away all colour from the tranſparent white glaſs, and to impart any kind deſired, to proper compoſitions on other occaſions, is of the next great moment to the being able, by the moſt cheap and eaſy means, to procure a due vitrification.

According to the above ſpecified intentions, in which the ſeveral ſubſtances ſerving for the materials of glaſs are uſed, they may be properly diſtinguiſhed into three kinds, as making the *body*, *flux*, and *colorific matter*.

The ſubſtances which have been employed in forming the *body* of glaſs are ſand, (by which is only to be underſtood the white kinds) flints, talc, ſpar, and ſeveral other ſtony foſſiles. All theſe vitrify of themſelves too ſlowly to produce perfect glaſs by the degree of heat that

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can be applied to them when in larger maſſes; which makes them therefore require the addition of thoſe other kinds whoſe fluxing power may remedy this defect in them; while they, on the other hand, being of low price, and to to be procured in unlimited quantities; and giving that hardneſs, ſtrength, and inſolubility which cannot be had in any glaſs formed of other ſubſtances without them, are yet eſſential and indiſpenſibly neceſſary ingredients in all kinds of manufactured glaſs.

The ſubſtances which are uſed as *fluxing* ingredients in glaſs, are red lead, pearl-aſhes, nitre, ſea ſalt, borax, arſenic, the *ſcoria* of forges, commonly called *clinkers*, and wood-aſhes containing the calcined earth and lixiviate ſalts, as produced by incineration. The preſence of ſome of theſe bodies is always equally neceſſary with that of thoſe which form the body, in all the compoſitions of manufactured glaſs. But the uſe of them, both with reſpect to choice and proportion, is greatly varied in different works, even where the ſame kind of glaſs is intended to be produced; as the general nature of them has never been hitherto underſtood by the directors of ſuch works, and they have only implicitly followed the beſt receipts they could procure, carefully keeping them ſecret, when they happened either by communication or their accidental diſcovery to be poſſeſſed of ſuch improvements as gave them any advantages over their fellow operators.

The ſubſtances which have been applied as *colorific matter* in manufactured glaſs, are extremely numerous and various; as all the ſpecies of metals and ſemi-metals, with many other mineral and foſſile bodies, have been uſed for the producing ſome colour or other, and make a large field of ſpeculative and practical knowledge. The art of ſtaining glaſs, with all the variety of colours in the greateſt degree of force and brightneſs is not, however, of ſo much importance, commercially conſidered, as the knowing how to baniſh and exclude, with eaſe and certainty, the colours which of themſelves ariſe in moſt of the compoſitions for glaſs intended to be perfectly tranſparent and colourleſs. For this laſt purpoſe, nitre and magneſia are the principal ſubſtances employed in the manufactures of this country, and extremely well anſwer the end, though not without enhancing the expence of the glaſs by the uſe of the firſt, and in a ſmall degree injuring its tranſparency by that of the latter, as may be demonſtrated by principles that are unqueſtionable in themſelves, though wholly unknown to thoſe who are practically concerned in theſe matters.

From theſe three kinds of ſubſtances, duly combined together by commixture and adequate heat, or, in ſome caſes from the two firſt only, all the ſorts of manufactured glaſs at preſent in uſe are formed; the general manner of doing which is to reduce thoſe kinds of bodies, that are in groſſer maſſes, to powder;

der; and then, all the ingredients being thoroughly well mixt together by grinding, and put into proper pots, to place them in a furnace where the heat is ſufficient to bring them to a due ſtate of fuſion, in which they are to be continued till the vitrification be completed.

This proper degree of vitrification muſt be diſtinguiſhed by the tranſparent and equal appearance of the matter, when a ſmall portion is taken out and ſuffered to cool, except in the caſe of thoſe ſorts where the glaſs is not perfect; with regard to which a judgment muſt be made from their having attained or wanting that peculiar appearance which the particular ſort is required to have. It may be proper to ſubjoin, that in all caſes the vitrification is ſooner and more eaſily made perfect in proportion as the ingredients are reduced to the ſtate of a finer powder, and more intimately commixt.

CHAP. II.

Of the particular nature of the materials ufed in the compofition of manufactured glafs.

SECTION I.

Of the materials ferving for the body of glafs.

THE materials employed to give a body to glafs are fand, flints, talc, fpar, and fome other ftony and terrene foffiles.

Sand is, at prefent, almoft the only kind of fubftance which is ufed in this intention in the Britifh manufactures of glafs; and with great reafon, as it extremely well anfwers the purpofe, and does not demand the previous preparation of calcination that is neceffary with refpect to flints and other ftones, and as it can be with certainty procured in any quantity demanded. The kind of fand moft fit for making the white tranfparent kinds of glafs is that brought from Lynn, in Norfolk, by the name of which place it is diftinguifhed; and there is alfo another kind of this, but inferior, brought from Maidftone, in Kent. It is white and fhining; and, examined by means of a microfcope, appears to be fmall fragments of rock

rock chryſtal, from which it does not ſeem, by any experiments, to differ in its qualities, and the glaſs formed of it may, therefore, properly be conſidered as made of chryſtal. The introduction of the uſe of it into the manufactures of glaſs in this country has almoſt wholly ſuperſeded that of flints, from which it no way differs in this application, but in the being ſomewhat ſlower in vitrifying, which makes it require in proportion a greater ſtrength of flux and fire; but to compenſate for this diſadvantage, it is clearer in its own colour, and much freer from heterogeneous tinging bodies, which injure the colour of the glaſs, and frequently give embarraſſment where flints are uſed. The ſand requires no previous preparation for common and groſſer purpoſes, eſpecially where nitre is uſed, which burns out the ſulphureous matter from any filth of the nature of animal and vegetable ſubſtances, and conſequently calcines them to an earth no way injurious to the glaſs; but for nicer purpoſes, and where no nitre is uſed, it is proper to purify or cleanſe the ſand by waſhing, which may be thus done. Pour water upon it, and, having ſtirred them well about, incline the veſſel immediately in ſuch manner that the water may run off and carry with it the filth that will float in it; by repeating which a few times, the ſand will be freed from all the heterogeneous matter that is lighter than itſelf. For coarſe glaſs, other kinds of ſand of a ſofter texture are uſed, as, beſides the advantage of being

being cheaper, they are more eaſily vitriable than flints, and conſequently make a ſaving in the *fluxing* bodies which are to be added to them.

Flints are the next important article in the ſubſtances which are uſed for forming the body of glaſs, and were indeed the only kind employed in larger works where any better ſorts of glaſs were manufactured, before the uſe of the white ſand excluded them in all places where it is to be conveniently obtained; ſince, for the reaſons above given, it is a more eligible material, unleſs for experiments, or where very ſmall quantities are required, in which caſe the calcined flints being more eaſily reduced to an impalpable powder, may poſſibly be more commodiouſly employed than the ſand. Flints yet, however, continue to be uſed wherever the proper ſand cannot be procured, at a reaſonable charge, as the ſole ingredient for forming the body of the better kinds of glaſs; ſince they are, in moſt places where they are naturally found, to be had in extreme great quantities, and the expence of calcining them does not enhance their whole coſt to a degree beyond what the current price of glaſs may bear. The goodneſs of flints, with reſpect to this uſe of them, muſt be diſtinguiſhed by their clear tranſparent black colour, and all ſuch as are marbled with brown or yellowiſh colour ſhould be rejected for fear of iron, which frequently lurks in them under that appearance, and is very injurious to the colour of glaſs if it get

get admiſſion into it. Such ſhould, therefore, be carefully pick out when found in parcels of the clearer ſort; but if the greater part of any parcel appear ſo marked, it ſhould not be uſed till trial be made, in a ſmall quantity, whether the diſcolouring be owing to any ſubſtance detrimental to the colour of glaſs or not. It is always neceſſary that flints ſhould undergo a calcination before they be uſed in the compoſition of glaſs, as well becauſe they are not otherwiſe to be reduced to a texture, which will admit of their being powdered, in order to their due commixture with the other ingredients, as becauſe they are not ſuſceptible of vitrification till a proper change be produced in them by *calcination*. This calcination muſt be performed by putting them into a furnace of a moderate heat, being firſt dipt in water, and continuing them there till they become intirely white, even to the moſt interior part, which will require a greater or leſs time, according to their magnitude, and the degree of heat of the furnace. When they are thus rendered white they muſt be taken out of the fire, and inſtantly immerſed in cold water, where they muſt remain till they be again cold; and then they will be found, if duly calcined, to be cracked and ſhivered into flaky pieces, and to become ſo ſoftly brittle as to be eaſily reducible to powder. Some part will nevertheleſs be always found inſufficiently calcined, which may be diſtinguiſhed by their harder and more obdurate conſiſtence, and they

they muſt be carefully ſeparated in order to be re-calcined, as they will otherwiſe greatly retard and impede the powdering of the duly calcined parts. Thoſe which are properly calcined muſt then be levigated by means of mills or other implements, accordingly as the quantity or opportunity may make it expedient, and they will then be fit for uſing in the compoſitions for glaſs.

Talc of various ſpecies has been likewiſe uſed in the ſame intention as ſand and flints, but ſeldom in large works. It ſometimes requires a calcination in order to its due preparation for entering into the compoſition of glaſs; but neither ſo great a heat, nor the quenching in cold water, are neceſſary for bringing it to a proper texture to bear powdering. Some ſorts of talc are much more quickly vitrifiable than others, and, fuſing eaſily with either ſalt of tartar or lead, may therefore be uſed in default of flint, or ſand ſufficiently white. But, with reſpect to larger manufactures, the uſe of flints is more eligible, as they are to be procured in great quantities with more certainty, and will, in general, require much leſs flux and fire to bring them to a due ſtate of vitrification.

Several other, both earthy and ſtony, foſſiles, have been likewiſe uſed for forming the body of glaſs; and it has been obſerved, that moſt kinds of ſtony ſubſtances, which will ſcintillate or ſtrike fire with ſteel, are vitriable within the degree that fits them for this purpoſe.

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But, as they are neither uſed at preſent, nor promiſe to be any way advantageous in practice, as far as is hitherto known of them, I ſhall omit enumerating them, as being foreign to the purpoſe in hand, except with reſpect to two kinds. The one of theſe is called *moilon* by the French, and is found in great quantities, as an upper cruſt in many freeſtone quarries; and, as it may be uſed without any previous preparation, and is very quickly vitrifiable, may be ſerviceable, on ſome occaſions, to thoſe who may want to form glaſs or vitreous compoſitions, where this may be procured with more eaſe than any of the before-mentioned ſubſtances. The other is the white round, ſemi-tranſparent, river pebbles, which vitrify very ſoon; and, if choſen colourleſs, make a very white glaſs; but they muſt be calcined, as the flint, by putting them into the fire till they be red hot; and then quench them in cold water, in order to bring them to a ſtate fit to undergo powdering.

Kunckel confounds the calcined flints, and all other ſtones, uſed for making glaſs, under the name of ſand, in his receipts; notwithſtanding, he admits of a great difference in their readineſs to be vitrified; as in the caſe of calcined flints, and the ſofteſt kind of natural ſand, where one hundred and forty pounds of ſalt are required to a hundred and fifty pounds of the calcined flints, and only one hundred and thirty pounds of ſalt to two hundred pounds of the ſand.

SECT.

SECTION II.

Of materials uſed as fluxes in the compoſition of glaſs.

THE materials uſed for the fluxes in the compoſition of manufactured glaſs are lead, pearl-aſhes, nitre, ſea-ſalt, borax, arſenic, ſmiths clinkers, and wood-aſhes containing the earth and lixiviate ſalts as produced by incineration.

Lead is the preſent moſt important flux in the Britiſh manufactures of what is called *flint glaſs*; but it muſt be brought, by previous calcination, to the ſtate of minium, or what is called red lead. This, uſed in a due proportion, makes a tougher and firmer glaſs than can be produced from ſalts alone, and is yet procured at a very ſmall expence. But all the glaſs formed of lead is tinged originally with yellow, and therefore requires the addition of nitre to burn and deſtroy the ſulphur or phlogiſtic matter it contains, in order to bring it to a more colourleſs ſtate, which addition of nitre enhances again the coſt of glaſs ſo compoſed, that would otherwiſe be extremely low. There is another reaſon likewiſe for the addition of nitre, or ſome other ſalt, to operate as a flux in the glaſs compounded with lead, which is, that there may not be a neceſſity of uſing beyond a certain

tain proportion of it. For, if glaſs have much lead in its compoſition, it will ſuffer a corroſion by the air, which gives a greyiſh dulneſs to its ſurface that is very injurious both to its beauty and utility. It is needleſs here to teach the maner of calcining lead, becauſe it is done in works appropriated to that purpoſe, and is ſold by the proprietors of theſe works at a cheaper rate than any particular perſons could pretend to manufacture it for their private uſe. The perfection of red lead lies in its being thoroughly well calcined, which is beſt diſtinguiſhed by its redneſs, inclining to crimſon, and in its being pure, which may be judged of by the brightneſs of its colour. There is indeed no materials of a red colour cheap enough to adulterate it with, except powdered bricks, or ſome of the red okers; and they would immediately ſhew themſelves, in the vitrification of the ſmalleſt quantity, by the ſtrong yellow tinge they would give the glaſs.

Pearl-aſhes is the next leading article among the ſubſtances uſed as fluxes in glaſs, and they at preſent moſtly ſupply the place of the Levant-aſhes, the barillas of Spain, and many other kinds, which were formerly brought here as well for making glaſs as ſoap. In the kinds of glaſs where perfect tranſparency is wanted, as in looking-glaſs plates, and all kinds of window-glaſs, ſalts are preferable as a flux to lead; and, conſequently, the pearl-aſhes become the principal matter of the flux; for

for, as all the lixiviate or fixt alkaline ſalts of vegetables are the ſame for this purpoſe when pure, and thoſe called pearl-aſhes are purer than any other which can be provided at a moderate expence, the uſe of them is more expedient than of any other. This kind of fixt alkaline ſalts, called pearl-aſhes, is prepared in Germany, Ruſſia, and Poland, by melting the ſalts out of the aſhes of burnt wood; and, having reduced them again to dryneſs, evaporating away the moiſture, and calcining them for a conſiderable time in a furnace moderately heated. But, as they cannot be prepared with advantage in this country, (though in America they unqueſtionably might, and indeed are of late) and are to be had at a reaſonable price by thoſe who may have occaſion to uſe them in making glaſs, I ſhall wave entering more particularly here into the detail of the proceſs by which they may be beſt and moſt profitably produced, as not properly falling within the intention of this work. The goodneſs of pearl-aſhes muſt be diſtinguiſhed by the equal and white appearance of them; as it conſiſts in their purity, and their having been calcined for a long ſpace of time, of which the whiteneſs and equal appearance are marks, unleſs in the caſe of ſome parcels that contain lumps of a bluiſh caſt produced by the calcination; which diſcolouring is not, however, any proof of their being bad; but any browniſh caſt in particular parts, or greyneſs in the whole,

whole, is a certain criterion of their not being good. This muſt, however, be confined to ſuch as are perfectly dry, which can only well be on the opening the caſks they are brought over in; for, if the air have acceſs to them, they ſoon deliquiate and look brown or greyiſh, from a ſemi-tranſparency they acquire in that deliquiating ſtate. There is one, and the moſt common adulteration, which is made in theſe ſalts, that is not eaſily diſtinguiſhable by the appearance; it is the addition of common or ſea ſalt to them, which is ſometimes copiouſly made. This is not, however, very detrimental in the application of them to the forming glaſs; but it is, nevertheleſs, a diſadvantage conſiderable enough in large concerns, to buy one thing for another at ſix times its current price. As it is expedient, therefore, to know how to diſtinguiſh this fraud, the following method is propoſed as eaſy and certain.

Take a ſmall quantity of the ſalt ſuſpected, and, after it has lain in the air ſo as to be a little ſoftened but not melted, put it in a fire-ſhovel, and hold it over the fire where the heat is pretty ſtrong. If it contain any common ſalt, a crackling, and, as it were, ſlight exploſion will follow as the ſalt grows hot, which decrepitation is a certain mark of common ſalt wherever it is found.

The pearl-aſhes require no preparation, except where extreme great tranſparency is required, as in the caſe of looking-glaſs, and

 the

the beſt window glaſs; in which caſes a purification is neceſſary, in the manner which will be ſhewn in ſpeaking of theſe particular kinds.

Nitre, in its refined ſtate, in which it is commonly called ſalt petre, has been formerly much uſed as a flux in the finer kinds of glaſs, and is now likewiſe employed in moſt compoſitions of the ſame nature. But this is a noted one, by thoſe who are at all acquainted with the principles of the art, ſo much in the intention of a flux, as in that of a colorific ingredient, from its power of rendering glaſs colourleſs, by deſtroying the phlogiſton in lead, or in any vegetable or animal matter which may tinge the glaſs, as we ſhall have occaſion to obſerve more particularly in its proper place. As a flux, it is leſs powerful than fixt alkaline ſalts of vegetables; and, being dearer by much, its uſe would therefore be in proportion leſs expedient than that of pearl-aſhes, if it were to be employed in this view only. The ſalt petre that is uſed here is brought from the Eaſt-Indies, in the form of what is called crude nitre, and, in commercial language, rough petre, in which ſtate it is commixt with ſome proportion of common ſalt. It is refined by perſons who make it their proper buſineſs, and bought for the purpoſes of glaſs-making in the ſtate of ſalt petre; on which account, it is unneceſſary to give the proceſs for refining it here. If it be obtained in chryſtals of ſuch a ſize that the figure of them may be diſtinguiſhable, there

there is no hazard of any adulteration but what would be very apparent, as no heterogeneous matter can be made a proper part of ſuch chryſtals, and, therefore, if they appear bright and colourleſs, the goodneſs cannot be doubted.

Sea ſalt is alſo frequently uſed as a flux in the making glaſs of various kinds, and it has a very ſtrong power in promoting vitrification even in ſome obdurate bodies; but, uſed in a large proportion, it does not produce ſo ſtrong and tenacious a glaſs as lead, or even the alkaline ſalts of vegetables, and is therefore only taken in aid of the others, when admitted as an ingredient. It ſhould be brought to a dry ſtate by *decrepitation*; that is, keeping it in a moderate heat till it ceaſes crackling, before it be put with the other ingredients into the fuſing heat; otherwiſe, by the little exploſive burſts of its parts, it will drive ſome of the powdered matter out of the pot. It muſt not, after ſuch decrepitation, be again expoſed to the air; for, if it be, it will regain its former quality of crackling in a ſhort time.

Borax is the moſt powerful flux of all the ſalts, or, indeed of any known ſubſtance whatever; but, on account of its great price, can only be admitted into the compoſition of glaſs deſigned for looking-glaſs plates, or other purpoſes, where a conſiderable value can be ſet on the produce, or where the quantity wanted is very ſmall. It is brought from the Eaſt-Indies, under the name of tincal, and the re-

ſinement of it in a perfect manner is hitherto known but to few perſons in Europe, who carefully keep it ſecret. The knowledge of it, however, is not important to the art of making glaſs, as it is always procured for that purpoſe in a refined ſtate, and not uſed in very large quantities. The purity of it may be aſcertained by the largeneſs and clearneſs of the chryſtals, for, when it is had in that ſtate, it may be always concluded good. The previous preparation of borax for the compoſition of glaſs, is to calcine it with a gentle heat, which converts it to a flaky, feathery kind of ſubſtance, like calcined alum, after which it ſhould be ground to powder, and is then fit to be commixt with other ingredients. This calcination of borax ſhould be with a gentle heat, and in a very large veſſel proportionably to the quantity, for it ſwells and riſes in inflated bladders ſo as to occupy a very great ſpace.

Arſenic is alſo a powerful flux, but muſt not be added, nevertheleſs, in too great quantity; for, though when once vitrified perfectly, it greatly promotes the ſame change in other ſubſtances, yet, when added in a redundant proportion, it turns the glaſs milky or opake, and keeps it in that ſtate a conſiderable time before it will duly aſſimilate, from whence the due vitrification is greatly retarded, ſo as to occaſion an intolerable loſs of time and fuel. Though the glaſs in all ſuch caſes would become clear, if continued long enough in the fire, yet, on this principle of

of its flowneſs in vitrifying when added to compoſitions of glaſs in a large proportion, it is uſed for giving an opake white colour to glaſs, as we ſhall ſee below.

Wood-aſhes, by which is to be underſtood, likewiſe, thoſe of broom, furze, or any other burnt vegetable are uſed as a flux for the common bottle or green glaſs. The aſhes muſt be taken in their original ſtate, conſiſting of the calcined earth of the vegetable, and their lixiviate or alkaline ſalt, as their virtue lies in their original manner of commixture; for this very extraordinary circumſtance attends them, that though in their primitive ſtate they vitrify eaſily, and act as a ſtrong flux to any of the vitreſcible earths or ſtones; yet, if the ſalts be ſeparated from the earth by ſolution in water, the earth from that time becomes extremely repugnant to vitrification, and though the ſame ſalts which were taken away from it, or even a much larger quantity be again added to it, it reſiſts their fluxing power, and diſplays a nature intirely different from that which it appeared to have before its ſeparation from the ſalts. There is no preparation neceſſary for theſe aſhes in order to their entering into the compoſition of glaſs, except the ſifting them to free them from all the fragments of charcoal, or unburnt parts of the vegetables employed in their production; but they ſhould be carefully kept from damp and moiſture, which would make the ſalts deliquiate and run off from the earth. The goodneſs of theſe

ashes must be distinguished by their appearing free from impurities, and by their whiteness, and their abounding in salt is likewise a proof of their excellence, which may be examined, by making a lixivium of any known small quantity, and judging of its strength by its weight.

SECTION III.

Of the materials used to make glass colourless.

AS the substances used for producing the various colours in glass will more properly come in question when I treat particularly of that art, I will omit speaking of them here, and only at present inquire into the nature of nitre and magnesia, which are two ingredients used for rendering the glass colourless that is intended to be so; and which, indeed, is the kind much the most generally useful, and what makes the only subject of great manufactures.

The general nature of nitre, or salt petre, has been before observed in speaking of it as a flux, and it only remains to explain that quality of it by which it operates in destroying the colour in those compositions of glass where it is used for that purpose. This quality is the power of ascending and supporting in

in a combuſtible ſtate all bodies which contain phlogiſtic and ſulphureous matter, if they be brought in contact with it in a certain degree of heat, by which means ſuch ſulphureous or phlogiſtic matter is deſtroyed; or, in other words, it has the ſame combuſtible power with the air in making bodies burn till they be reduced to the ſtate of a calx. In this intention, therefore, ſalt petre is made an ingredient in thoſe compoſitions for tranſparent colourleſs glaſs where lead is uſed as a flux; for ſuch glaſs, having, otherwiſe, a ſtrong tinge of yellow from the phlogiſton of the lead, requires, conſequently, the deſtruction of the phlogiſton, at leaſt to a certain degree, in order to its being freed from this tinge. This operation of the nitre on the lead is moſt obviouſly apparent, if a piece of ſalt petre be thrown into melted glaſs formed of lead; for a detonation or exploſive effect immediately ſhews itſelf, and continues till the acid contained in the ſalt petre be conſumed.

The diſtinct knowledge of this principle clearly points out in what compoſitions of glaſs nitre is neceſſary, and, in ſome degree, what the proportions may be in which it ſhould be added to each kind, as ſuch proportion muſt be regulated by the quantity of phlogiſton to be deſtroyed; for, as has been before obſerved, conſidered merely as a flux, it is dearer than the pearl-aſhes, without any advantage but the being ſomewhat more void of colour. This is obvious, as it is not only of double

the price, but weaker in its action, unleſs where meeting with phlogiſtic matter in any of the other ingredients, it be deprived, as was above intimated, of its acid ſpirit, and converted, as it then will be, to exactly the ſame kind of fixt alkaline ſalt with the pearl-aſhes themſelves, but in the proportion of only one-third of its original weight. In glaſs formed of lead, therefore, the uſe of nitre is abſolutely neceſſary, and, in glaſs of ſalts only, where the colour is to be intirely deſtroyed, and great tranſparency is wanted, as in the caſe of looking-glaſs, and ſeveral other kinds of plates, it is alſo requiſite in a leſs proportion; for, though the appearance of any ſlight yellow tinge may be taken away by the uſe of the magneſia, yet that (for the reaſon we ſhall ſee below) is always attended with a proportionable loſs of the tranſparency.

Magneſia is the other ſubſtance employed for rendering glaſs colourleſs. It is a foſſile that partakes of the nature of iron ores, but does not contain any conſiderable quantity of that metal, and ſometimes only a very little. It is found in almoſt every country amongſt other iron ores, and frequently alſo above the beds of lead ore, where, indeed the beſt ſeems to have been always found, probably from its being leſs replete with iron than ſuch as is found in the beds of that metal. The hills near Mendip, in Dorſetſhire, have particularly afforded extremely good. It is not of any peculiar ſhape or figure, but ſomewhat ſtriated

ſtriated like antimony in its texture, and of a browniſh black colour like ſoot. The marks of its being good is the deepneſs of the colour, and the being free from ſpecks of a metalline appearance, or a lighter caſt, and that ſhould be particularly rejected which has ſpots of a reddiſh brown, or yellowiſh colour, as being ſigns of the preſence of iron.

When fuſed with glaſs of any kind it readily vitrifies, and tinges the glaſs of a ſtrong reddiſh purple colour, but not clear and bright. In conſequence of this quality, it is uſed for deſtroying any ſlight yellowiſh or greeniſh tinge in glaſs that is required to be colourleſs, on the following principle. The three primitive colours of yellow, red, and blue, when mixed in due proportion, deſtroy each other, and produce the effect of grey in the caſe of opake bodies, and of black in ſuch as are tranſparent. Now the tinge of magneſia in glaſs being purple, which is a compound of blue and red, and being added to the greeniſh or yellowiſh tinge of the glaſs, conſequently deſtroys the appearance of it, eſpecially the greeniſh, as the proportion of red in it is greater than that of the blue; but a proportion of black being produced, the glaſs is obſcured in the ſame degree, though not ſo as to be perceptible to the eye, without comparing it with ſome other more pellucid. This is a reaſon for uſing the magneſia ſparingly, or rather avoiding it entirely in thoſe compoſitions of glaſs where great tranſ-

parency

pararency is demanded, and for forming them of ſuch ingredients as are moſt colourleſs, or may be rendered ſo by the uſe of nitre. Magneſia requires to be well calcined in a hot furnace, and then to undergo a thorough levigation; for it ought to be in the ſtate of an impalpable powder, in order to its perfect commixture with the other matter. It was formerly practiſed to quench the magneſia ſeveral times in vinegar after reiterated calcinations, with a view of freeing it from any iron that might be mixt with it; but this was needleſs, and is now intirely diſuſed. Its application to the colouring glaſs, in which it is very efficacious for many purpoſes, we ſhall ſpeak of in its proper place.

CHAP. III.

Of the inſtruments and utenſils employed in the compoſition and preparation of glaſs.

THE inſtruments and utenſils employed in the compounding and preparing glaſs are of two kinds, as they are ſubſervient to two different purpoſes; *the levigation and commixture of the ingredients*, and *the fuſion or vitrification of them.*

The

The inſtruments ſubſervient to levigation, and the mixture of the ingredients are horſe or hand-mills, mortars and peſtles, and flat ſtones and mullars.

The horſe, or hand-mills, may be ſuch as are uſed for other purpoſes; but the ſtones ſhould be of a very hard texture, in order that as little as poſſible of the matter of them may be abraded and commixt with the glaſs.

Where large mortars are uſed for ſuch ingredients as are not employed in a ſufficient quantity to make it commodious to grind them in mills, they ſhould be of caſt iron, with peſtles of the ſame, and ſhould be carefully kept from ruſt. But for very nice purpoſes, where the quantity of the matter is ſmall, mortars ſhould be had of bottle or green glaſs, or of flint or agate, as alſo a ſtone and mullar of porphyry or agate, for levigating the calces of metals, or other ingredients uſed in colouring glaſs.

Searces or ſieves of fine lawn ſhould likewiſe be provided for ſifting ſome of the levigated ſubſtances. They ſhould be like thoſe of the apothecaries and druggiſts, with a cover fitted to the upper part, and a box to the under, for preventing that waſte of the matter which attends the ſifting in the open air.

The utenſils employed in the fuſing or vitrifying the matter of glaſs are furnaces, with the proper iron work, pots for containing the compoſitions when put into the fire, with the iron inſtruments for ſhifting the matter from one

one to the other, in caſe of accidents; and for taking out ſmall portions to judge of the progreſs of the vitrification, and the qualities of the glaſs.

The ſtructure of the furnaces for preparing and working glaſs in large is ſo well and commonly known, that it is needleſs to enter into the detail of it here. Where ſmaller quantities are prepared, as in the caſe of coloured glaſs, or paſtes in imitations of ſtones, the common wind-furnace, or the athanor of the chymiſts, may be uſed; or a furnace may be made for this particular purpoſe, which may be conſtructed in the following manner.

Mark out a circular area of one yard diameter, and let a cylindrical building be raiſed upon it of good ſtock bricks and coal-aſh mortar, of the height of twelve inches. This cylinder muſt have an hollow area in the middle, of a round form, twelve inches in diameter; the reſt of the ſpace being filled with ſolid brick-work. But an opening muſt be left in the front at the bottom, which muſt be ſix inches broad and four high, for taking away the aſhes; and it ſhould likewiſe have an iron frame and door, like thoſe commoly uſed for feeding the fire in furnaces, that it may be occaſionally cloſed in order to check or extinguiſh the fire. This cylindrical fabric being raiſed to the height of twelve inches, a grate for bearing the fuel, compoſed of a ſtrong iron ring with bars let into it, muſt be laid over the

round

round hollow, and another cylinder, of the ſame diameter and thickneſs of wall, muſt be raiſed in like manner to the height of eight inches above the bars; but this ſhould be done with Windſor bricks, and the mortar formed of Windſor loom, where they can be obtained, and care ſhould be taken likewiſe that the brick-work may have good hold of the rim of the grate. At the height of about five inches above the bars, a frame and door ſhould be fixed for feeding the fire. The door ſhould be about five inches high, and eight long, and ſhould have a ſtrong latch going a-croſs the whole breadth of it, by which it may be opened and ſhut. When the cylindrical hollow over the bars is thus carried eight inches high, a larger area muſt be taken of twenty-four inches diameter, and the brick-work muſt be carried up round it, in the ſame cylindrical manner as at firſt, for ten inches more, except that four iron doors and frames of the ſame form with thoſe for feeding the fire muſt be fixt in the brick-work. The dimenſions of theſe doors ſhould be twelve inches high, and eight in breadth, and the loweſt part of them ſhould be level with the flooring made by the brick-work on enlarging the area of the cavity of the furnace; or, in other words, where the brick-work of this wider cylinder begins. Theſe doors ſhould be placed at equal diſtances from each other, and in ſuch manner, that the other for feeding the fire may be exactly in the middle betwixt the two neareſt to the front,

front, and the chimney betwixt the others. A hole ſhould be likewiſe left for venting the ſmoke into the chimney, which may be ſix inches broad and three high; and after this the brick-work may be brought together in the manner of an arch, till the whole cavity be covered. For the whole of this upper part, Windſor bricks and Windſor loom ſhould be uſed, or, where they cannot be procured, ſuch other as are moſt like them in their quality of bearing intenſe heat, without either being calcined or vitrified. The manner of uſing this furnace is too obvious to require explanation, it being enough apparent that the flooring in the enlarged cavity is intended for the pots or crucibles containing the matter, and the four doors for the more conveniently putting them in, and taking them out. When, however, they are to be placed in the furnace, it ſhould not be on the parts before the doors, for fear the ſtream of cold air, on opening the doors occaſionally, may crack them; but they ſhould be conveyed through one of the doors to the oppoſite ſide, by means of an iron peel, formed like thoſe of the bakers, and put betwixt the doors on that ſide, by which means they will not only be much ſafer, but will be out of the way of impeding the operator from ſeeing what paſſes in every part of the furnace; and, by this means, likewiſe, room may be found for many more pots and crucibles than could be introduced if the firſt four ſtood before the doors, and blocked up the entrance

entrance againſt any other. When this furnace is wanted for calcinations, or other operations that require leſs heat, the area of the cylinder ſhould be made leſs by bricks formed of Windſor loom and ſand, and adapted to the cylindrical figure of the cavity; which bricks may be eaſily put in, or taken out, by means of the four doors in the upper part, and that in the lower for feeding the fire. The dimenſions of this furnace are calculated to anſwer the purpoſe of thoſe who may engage in theſe matters for profit, and may be enlarged if there be yet occaſion; but for ſuch as meddle with them ſpeculatively, and in the view of experiments only, they may be proportionably contracted, as being much larger than needful.

The pots for containing the melted matter of the glaſs ſhould be formed of the clay uſed for making tobacco-pipes, or of the beſt potters clay that can be procured. But as there is ſeldom any ſuch clay found as will ſtand the drying and burning well, without the admixture of ſome earthy body, broken crucibles ground to powder, or, in default of them, white ſand, or calcined flints, duly levigated, may be added. Near London, the tobacco-pipe-clay, or the Sturbridge clay, with a fourth or fifth of ground crucibles or ſand, are the beſt materials that can be uſed; but care ſhould be taken to free the clay perfectly from ſtones or gravel, and to incorporate the ground crucibles or ſand well with the clay. When the

the tobacco-pipe-clay is uſed, it is previouſly calcined, and then ground to powder, and afterwards moiſtened with water, then well beat in the manner of mortar.

Small pots for making paſtes or coloured glaſſes may be formed on a wooden mold, and ſhould be ſlowly dried, and afterwards baked or burnt in a fire very gradually increaſed to a ſtrong degree, and then ſuffered to extinguiſh before the pots be taken out of the furnace. This may be done commodiouſly in a potter's kiln, along with earthen or ſtone-ware; but the pots ſhould be placed in the hotteſt part of the furnace. They otherwiſe may be burnt, where other conveniencies are wanting, commodiouſly enough in the furnace above-mentioned, and if intended to be uſed in ſuch furnace, the largeſt may be ſix inches diameter, and ten or twelve inches in height. However, they muſt be formed a little conical or narrower at the bottom than the top, that they may be the more eaſily drawn from the mold, which need only to be a piece of wood turned into the form and dimenſions of the cavity of the pot.

CHAP. IV.

Of the preparation and compoſition of the ſeveral kinds of white tranſparent glaſs now in uſe.

SECTION I.

Of the ſeveral kinds of white glaſs, and their compoſition in general.

THE ſeveral kinds of white tranſparent glaſs now in uſe in this part of the world are the flint-glaſs (as it is here called) and the German chryſtal-glaſs, which are applyed to the ſame uſes and purpoſes;—the glaſs for plates for mirrors or looking-glaſſes;—the glaſs for windows and other lights;—and the glaſs for phials, and ſuch kinds of ſmall veſſels.

Of each of theſe kinds there are ſeveral ſorts; ſome only differing in the particular compoſition and management of the directors of the works where they are manufactured, but alike in their price, and the uſes to which they are applied; and others, which are allowedly inferior ſorts, ſold at cheaper rates, and employed accordingly for coarſer purpoſes.

The ſeveral kinds of glaſs differ in the ſubſtances employed as fluxes in forming them, as well as in the coarſeneſs or fineneſs of ſuch as are uſed for their body. The flint and chryſtal, mirror, and beſt window-glaſs, not only require ſuch purity in the fluxes as may render it practicable to free the glaſs perfectly from all colour, but, for the ſame reaſon alſo, either the white Lynn ſand, calcined flints, or white pebbles ſhould be uſed. The others do not demand the ſame nicety in the choice of the materials; though the ſecond kind of window-glaſs, and the beſt kind of phial, will not be ſo clear as they ought if either too brown ſand or impure ſalts be ſuffered to enter into their compoſition. It is to be greatly regretted, that the important manufacture of glaſs ſhould not be ſo cultivated and encouraged in Great Britain as to prevent totally the importation of the foreign; whereas, from the production of the ſand, lead, and coals in our own country, we may make the beſt ſorts of glaſs much cheaper than can be done elſewhere. We yet, however, take looking-glaſs plates of France, to the amount of a very conſiderable ſum; ſome window-glaſs of the Dutch; and the German drinking-glaſſes for water, with gilt edges and other ornaments, are now coming again extremely into faſhion. The cauſes of this demand for foreign commodities, which are, or might be better and cheaper manufactured here, are various, and the diſplaying them not being a proper part of my buſineſs at preſent, I ſhall

ſhall wave it, and only intimate, that the tax laid upon glaſs (againſt all the principles of good policy) has greatly corroborated them, as well as checked a growing exportation of ſome articles, which would probably in time have been of very great conſequence to our commerce.

SECTION I.

Of the nature and compoſition of flint-glaſs, and the German chryſtal-glaſs.

FLINT-glaſs, as it is called in our country, is of the ſame general kind with what is in other places called chryſtal-glaſs. It had this name from being originally made with calcined flints, before the uſe of the white ſand was underſtood, and, though no flints are now uſed in its compoſition, it retains ſtill the name. This kind differs, however, from the German and other chryſtal-glaſs, in being partly formed of lead, whereas the fluxing bodies employed for the others are only ſalts or arſenic, and in having a white ſand (which, as is ſaid before, appears to be fragments of chryſtal) for its body. Inſtead of which, calcined flints, or the white river pebbles, or other ſuch ſtones, are uſed for the chryſtal-glaſs in other places; there being no ſand of this kind of equal goodneſs found out of England, as far as is hitherto known.

The compofition of flint-glafs is, therefore, principally the white fand and lead, to which a due proportion of nitre is added, to burn away the phlogifton of the lead, which otherwife imparts a ftrong yellow tinge to the glafs, and to this is added, for hiding the remainder of the colour, a fmall quantity of magnefia; as alfo in fome works a proportion of arfenic, to aid the fluxing ingredients. Flint-glafs is not, however, a fimple glafs of lead; for where no other falts are added, yet the quantity of nitre ufed being confiderable, and fluxing a proportionable quantity of the fand, it muft be confidered as a compound glafs of falts and lead. But indeed it has been generally practifed, to add fome quantity of other falts to it, and diminifh proportionably the quantity of lead otherwife neceffary. The quantity, though great in the glafs made fome time ago, feems to be much diminifhed in that manufactured lately, at leaft in fome works, as appears from the fmall weight and tranfparency of what is now to be met with, as well as from the veffels being blown much thinner, and of lefs fubftance, than the glafs in which lead abounds could well bear to be. The admiffion of lead into glafs renders fuch glafs lefs hard and tranfparent than that made of falts only. But there is in glafs of lead a power of reflecting the rays of light, of the fame nature with that of diamonds and topazes, and gives a luftre and brilliant appearance to veffels of a round figure, not found in the

the mere glaſs of ſalts, where the too great tranſparency, and want of play, occaſion a poorneſs or deadneſs in the look, when ſeen by the other; and this likewiſe extends itſelf, in ſome degree, to the appearance of liquors contained in them. For polygonal veſſels however, or thoſe cut with flat ſides, or ſuch as are decorated with flowers, or other ornaments cut in them, or with gilding, the glaſs of ſalts is preferable, as may be obſerved in the inſtance of thoſe brought from Germany. This muſt not, nevertheleſs, be extended to ſuch pieces as are cut with a great number of angles for the parts of chandeliers, or other purpoſes where the play of the light is wanted; for in all other caſes, the glaſs formed with lead again takes place of the other, as producing a greatly ſtronger and more beautiful effect, for the reaons before given.

It appears from what has been ſaid, that flint-glaſs may be, as in fact it is, formed of various compoſitions, by altering the quantities of lead and nitre, and adding equivalent proportions of other ſalts or arſenic; in conſequence of which, ſavings may be made in the expence, and a difference will ariſe in the hardneſs or ſoftneſs of the glaſs. For the more the quantities of nitre or other ſalts are increaſed, and that of the lead diminiſhed, the more hard and firm the texture of the glaſs will be, and ſo vice verſa. I will therefore give a recipe for the compoſition of a glaſs, according to each of the ſeveral manners, in which the

proportions of the ingredients may be properly varied, and diſtinguiſh likewiſe, in each caſe, what the abſolute and comparative qualities of the glaſs produced will be, and with reſpect to the comparative expence, the quantities of the ſeveral ingredients being thus ſtated, it will be very eaſy for thoſe who are acquainted with the market price of them to make a computation.

N° 1. *Compoſition of the moſt perfect kind of flint-glaſs.*

" Take of the white ſand one hundred and
" twenty pounds, of red lead fifty pounds,
" of the beſt pearl-aſhes forty pounds, of
" nitre twenty pounds, and of magneſia five
" ounces."

If this compoſition be fuſed with a very ſtrong fire, and time be given to it, a glaſs will be produced that will have the play of the beſt flint-glaſs, and yet be hard and ſtrong. It is not ſo cheap as the compoſitions below given, where arſenic or common ſalt is introduced, or where more of the pearl-aſhes are uſed; in either of which caſes, ſavings may be made by diminiſhing proportionably the quantities of nitre. But the qualities of this glaſs will be found to come nearer to the ſtandard of perfection; which is to unite the luſtre and hardneſs together in the greateſt degree, they are compatible with each other.

If this compoſition be, however, deſired to flux with leſs heat and quicker, a pound or two of

of arſenic may be added, which will be found effectually to anſwer the purpoſe.

N° 2. *Compoſition of flint-glaſs with a greater proportion of ſalts.*

" Take of ſand one hundred and twenty
" pounds, of the beſt pearl-aſhes fifty-four
" pounds, of red lead thirty-ſix pounds, of
" nitre twelve pounds, and of magneſia ſix
" ounces."

This will require much the ſame fire as the other, but will be harder in its texture, and have leſs of the refractive play of the light; it is, however, a very good compoſition of glaſs, and comes nearer to the kind now made, though I imagine the proportion of lead is ſtill more diminiſhed in ſome I have ſeen than here. If it be deſired to be made more yielding to the fire, arſenic may be added, as is directed for the preceding, or the quantity of ſand may be leſſened, but in that caſe the glaſs will be ſofter and weaker.

N° 3. *Cheaper compoſition of flint-glaſs with arſenic.*

" Take of white ſand one hundred and
" twenty pounds, of the beſt pearl-aſhes thirty-
" five pounds, of red lead forty pounds, of
" nitre thirteen pounds, of arſenic ſix pounds,
" and of magneſia four ounces."

This glaſs will require a conſiderable time in the fire to become clear, and muſt not, if it can be avoided, be ſtrongly urged at firſt; for

the arſenic is apt to ſublime away, if the heat be violent before the other ingredients run into fuſion ſo as to detain it. It is well, therefore, to mix a conſiderable proportion of glaſs which has been wrought before, and is to be manufactured over again with this compoſition when it is uſed, which, running ſooner than the new mixt ingredients, will take hold of the arſenic and fix it. This compoſition ſhould however be afterwards fuſed with a conſiderable heat, and continued in that ſtate till the milky appearance of the arſenic, which it will ſometimes retain for a long time, be intirely gone. For notwithſtanding this apparent reluctance to perfect vitrification, the arſenic never fails at length to become very tranſparent glaſs, and even to contribute greatly to render the other ingredients ſo likewiſe. This glaſs will not be ſo hard as thoſe of the above compoſitions, but it will be very clear, and may be employed for the formation of large veſſels where a ſufficient thickneſs can be allowed to give them ſtrength.

N° 4. *Cheaper compoſition of glaſs by means of common ſalt.*

"Take the proportions of the other ingredients given in the laſt, and, omitting the arſenic, add in its ſtead fifteen pounds of common ſalt."

This will be more brittle than the laſt, and therefore cannot be recommended, unleſs for the fabrication of ſuch kind of veſſels or other pieces

pieces where the ſtrength is of little moment.

N° 5. *Cheapeſt compoſition of flint-glaſs, by the addition of arſenic and common ſalt.*

" Take of the white ſand one hundred and
" twenty pounds, of red led thirty pounds,
" of the beſt pearl-aſhes twenty pounds, of
" nitre ten pounds, of common ſalt fifteen
" pounds, and of arſenic ſix pounds."

This glaſs will fuſe with a moderate heat, but requires time, like the laſt, to take off the milky appearance of the arſenic; it is yet ſofter than the laſt, and may therefore be deemed the worſt kind of flint-glaſs that can be made, preſerving the appearance of good glaſs to the eye, which it will have equally with any other, when properly managed.

N° 6. *Compoſition of the beſt German chryſtal-glaſs.*

" Take of the calcined flints, or white ſand,
" one hundred and twenty pounds, of the beſt
" pearl-aſhes ſeventy pounds, of ſalt petre
" ten pounds, of arſenic half a pound, and of
" magneſia five ounces."

If the pearl-aſhes be pure and good, this glaſs will equal the beſt of this kind that ever was made. Borax has been frequently uſed alſo in the compoſitions for this ſort of glaſs; but its great price, without any equivalent advantage, will deter from the employing it in large manufactures, as there is no ſort of tranſ-

parent

parent glaſs in common practice, that of which looking-glaſs plates is made excepted, can bear the expence of it.

N° 7. *Cheaper compoſition of German chryſtal-glaſs.*

"Take of calcined flints, or white ſand, "one hundred and twenty pounds, of pearl-"aſhes forty-ſix pounds, of nitre ſeven pounds, "of arſenic ſix pounds, and of magneſia five "ounces."

This compoſition requires a long continuance of heat, on account of the arſenic, for the reaſon before given. It produces a glaſs equally, or more tranſparent and colourleſs than the preceding, but ſomewhat more brittle. The arſenic is, however, ſo diſagreeable an ingredient, from the deleterious qualities of the fumes, which will neceſſarily riſe copiouſly till the fuſion of the other ingredients check it, that, where the advantage is not more conſiderable than the ſaving ariſing from the difference of theſe two recipes, it is ſcarcely worth while to ſubmit to the inconveniencies of it.

SECT.

SECTION III.

Of the nature and composition of the glass proper for plates for mirrors or looking-glasses.

THE glass for forming the looking-glass plates in perfection is the most nice and difficult kind to manage of any whatever, there being no latitude, with respect to several of the qualities, as there is in the case of flint-glass, without its goodness being really impaired. These qualities are to be intirely transparent and colourless, to have as little power of refracting the rays of light as possible, to be intirely free from bubbles, specks, and flaws, and to be fusible with a moderate heat. Hardness of consistence is of less consequence in this kind of glass than in the flint, though it is an additional excellence, as far as it may be had along with the other qualities, since the plates may, in that case, be wrought thinner with the same degree of strength, which is a considerable advantage to mirrors made of them.

The white sand is the proper ingredient for forming the body of this kind of glass, as well as of the flint, and the principal part of the flux should be the fixt alkaline salt of vegetables, which the pearl-ashes will best furnish when duly purified. This salt must, however, be aided by borax or common salt, in order

order to facilitate the fusion, and prevent the glass from stiffening in that degree of heat in which it is to be wrought into plates. Lead is by no means a proper ingredient in the composition of this kind of glass, on account of its augmenting the refracting power, and for the same reason arsenic, which has the like effect, though in a much less degree, should be either omitted, or but sparingly used. The sand should be carefully cleansed for this use, by the means above directed for that purpose, p. 233, and the borax should be first calcined, and then rubbed to powder. The pearl-ashes must likewise be purified for this use, which may be done in the following way.

Manner of purifying the pearl-ashes.

" Take any quantity of the best pearl-ashes, " and dissolve them in four times their weight " of water boiling, which operation may be " best performed in a pot of cast iron. When " they are dissolved, let the solution be put " into a clean tub, and suffered to remain " there twenty-four hours or longer. Let the " clear part of the fluid be then decanted off " from the dregs or sediment, and put back " into the iron pot, in which the water must " be evaporated away till the salts be left per- " fectly dry again. They should then, if not " used immediately, be kept in stone jars well " secured from moisture and air, till such time " as they are wanted."

Great

Great care ſhould be always taken, in this treatment of the ſalts, to keep the iron pot thoroughly clean from ruſt, which would give a yellow tinge to the glaſs, not to be removed without greatly injuring it.

N° 1. *Beſt compoſition of glaſs for looking-glaſs plates.*

" Take of white ſand cleanſed ſixty pounds,
" of purified pearl-aſhes twenty-five pounds,
" of ſalt petre fifteen pounds, and of borax
" ſeven pounds."

This compoſition ſhould be continued long in the fire, which ſhould be for ſome time ſtrong, and afterwards more moderate, that the glaſs may be intirely free from bubbles before it be worked. It will be intirely clear of all colour, unleſs in caſe of ſome accident; but if any yellow tinge ſhould, nevertheleſs, unfortunately infect it, there is no remedy, except by adding a ſmall proportion of magneſia, which ſhould be mixed with an equal quantity of arſenic, and after their being put into the glaſs, giving it a conſiderable heat again, and then ſuffering it to free itſelf from bubbles in a more moderate one as before. If the tinge be ſlight, an ounce of magneſia may be firſt tried, and if that prove inſufficient, the quantity muſt be increaſed; but the glaſs will always be obſcure in proportion to the quantity that is admitted, though perhaps not in a degree that may prevent it from paſſing currently with thoſe who do not

examine

examine with great ſtrictneſs. This compoſition is not to be made without expence at the times when borax is dear; but the great price which looking-glaſs plates, particularly ſuch as are large, bear, will very well allow it; or even the adding a greater quantity of borax, when there is occaſion to have the glaſs run more eaſily, and roll in a leſs degree of heat.

N° 2. *Cheaper compoſition for looking-glaſs plates.*

"Take of the white ſand ſixty pounds, of
"pearl-aſhes twenty pounds, of common ſalt
"ten pounds, of nitre ſeven pounds, of ar-
"ſenic two pounds, and of borax one pound."

This glaſs will run with as little heat as the former, but it will be more brittle, and refract the rays of light in a greater degree. It is, therefore, worſe than the other in a greater degree, than is balanced by the ſaving in an article where the coſt of the materials is not conſiderable in proportion to the return; it being the work and ſkill, and not the prime expence of the ingredients, that make the high price of looking-glaſs plates. It would be conſequently unpardonable, while they continue to be ſold at the preſent dear rates they bear in this country, to impair the quality of the glaſs, for the ſake of a trifling ſaving out of the original price of the materials.

SECTION IV.

Of the nature and composition of window-glass.

IN order to have window-glass in the utmost perfection, the same qualities and treatment are required as for the looking-glass plates, and the same kind of glass is therefore used for lights where the expence can be allowed. But as that is only done in extraordinary cases, inferior kinds of various rates of price are wanted for more common purposes, where not only the cost of grinding may be saved, but even the glass itself afforded cheaper, on account of its composition. The best of these kinds is called *crown glass*, the composition for which may be as follows, the ingredients being previously prepared in the same manner as for looking-glass.

N° 1. *Composition of crown or the best window-glass.*

"Take of white sand sixty pounds, of purified pearl-ashes thirty pounds, of salt petre fifteen pounds, of borax one pound, and of arsenic half a pound."

This will be very clear and colourless, if the ingredients be good, and will not be very dear. It will run with a moderate heat; but if it be desired to be yet more fusible and soft, half a pound,

pound, or a pound more of arſenic may be added. If the glaſs ſhould prove yellow, the magneſia muſt be uſed as above directed for the looking-glaſs.

N° 2. *Compoſition for a cheaper kind of window-glaſs.*

" Take of white ſand ſixty pounds, of un-
" purified pearl-aſhes twenty-five pounds, of
" common ſalt ten pounds, of nitre five
" pounds, of arſenic two pounds, and of
" magneſia one ounce and a half."

This will be inferior to the above kind, but may be improved, where deſired, by purifying the pearl-aſhes. This operation will not only free them from the remaining part of the earth of the aſhes they were extracted from, (which is apt to give a ſmall degree of opacity to the glaſs, as it will not vitrify in this ſtate) but renders them alſo leſs liable to impart a yellow tinge to the glaſs; and, therefore, where the goodneſs of ſuch aſhes is known by trial, an ounce of the magneſia, or perhaps more may be ſpared.

N° 3. *Compoſition of common or green window-glaſs.*

" Take of white ſand ſixty pounds, of
" unpurified pearl-aſhes thirty pounds, of
" common ſalt ten pounds, of arſenic two
" pounds, and of magneſia two ounces."

This

This is a cheap compoſition, and will not much appear green, nor be very deficient in tranſparency.

N° 4. *Cheapeſt compoſition of common or green window-glaſs.*

"Take of the cheapeſt kind of white ſand "one hundred and twenty pounds, of unpu-"rified pearl-aſhes thirty pounds, of wood-"aſhes, well burnt and ſifted, ſixty pounds, of "common ſalt twenty pounds, and of arſenic "five pounds."

This compoſition is very cheap, and will produce a glaſs with a greeniſh caſt, but greatly ſuperior to what I have frequently met with; though nothing that will at all anſwer the end can be well prepared at leſs expence.

SECTION V.

Of the nature and compoſition of the glaſs for phials.

THE glaſs of which phials for the uſe of apothecaries, ink-bottles, and many other ſuch ſmall veſſels are made, is a kind betwixt the flint-glaſs and the common bottle or green glaſs; a very good ſort of which may be thus prepared.

N° 1. *Compoſition of the beſt phial-glaſs.*

" Take of white ſand one hundred and
" twenty pounds, of unpurified pearl-aſhes
" fifty pounds, of common ſalt ten pounds,
" of arſenic five pounds, and of magneſia
" five ounces."

This will be a very good glaſs for the purpoſe, and will work with a moderate heat, but requires time to become clear, on account of the proportion of arſenic; when, however, it is once in good condition, it will come very near to the chryſtal-glaſs.

N° 2. *Cheapeſt compoſition of green or common phial-glaſs.*

" Take of the cheapeſt kind of white ſand
" one hundred and twenty pounds, of wood-
" aſhes, well burnt and ſifted, eighty pounds,
" of pearl-aſhes twenty pounds, of common
" ſalt fifteen pounds, of arſenic one pound."

This will be green, but tolerably tranſparent, and will work with a moderate fire, and vitrify quickly with a ſtrong one.

CHAP. V.

Of the commixture of the ingredients for compoſing glaſs, and the manner of the fuſion and coction of the ſeveral compoſitions of the white tranſparent kinds, in order to their being duly incorporated and vitrified.

SECT. I. *Of the commixture of the ingredients for the ſeveral compoſitions of white tranſparent glaſs.*

THE commixture of the ingredients for making glaſs muſt be performed by lifferent methods, according to the nature of he ingredients that enter into the different compoſitions.

When ſand and fixt alkaline ſalts, whether n form of pearl-aſhes, or of ſuch as are exracted from them, or any other aſhes of veetables, are uſed together, they ought to be horoughly mixt, by grinding them in a place ree from damp. When they are ſo mixt, they hould be put into a proper calcining furnace, d there continued in a moderate heat for five ſix hours, being in the mean-time fre-

 quently

quently turned over and ſtirred about, by means of a proper rake, and at the end of that time taken out of the furnace, and either immediately uſed, or kept where no moiſture can have acceſs to them, till wanted. The matter in this ſtate is called *frit*, and may be converted into glaſs without further preparation than being broken into groſs powder before it be put into the pots, unleſs where other ingredients are to be added to it, in which caſe the following methods may be purſued.

When nitre is to be added to the frit, it ſhould be after the calcination, and if it be well powdered, it muſt be mixed with the frit without their being ground together.

If arſenic be alſo uſed, it ſhould, being previouſly well levigated, be mixed with the nitre at the time that it is to be powdered, and they may be then added together to the frit. But if no nitre be uſed, it ſhould be ground with ſome pounds of the frit, or rather with ſome of the ſalts of which the frit is made, and then put to it.

In the caſe of the flint-glaſs, when larg proportions of lead and nitre are admitted in the compoſition, or in other caſes of ſoft gla where very powerful fluxes are uſed, the ca cining the frit is diſpenſed with, and the ſan alkaline ſalts, lead, nitre, and alſo arſenic, any be uſed, are thoroughly mixt together grinding. But if a calcined frit be uſed, matter, after it has undergone that operati and been groſsly powdered, muſt be put i

the pot with the other ingredients in that ſtate, they being previouſly well commixt together by grinding.

If borax be uſed with the frit alone, it ſhould be ground with a ſmall part of it, and then mixt with the reſt. But, if other ingredients are to be added, it may be ground with them. It ſhould, however, be always firſt calcined, that is, placed in a moderate heat, till the ebullition it makes at firſt be over, and it be left in a dry ſtate.

When common ſalt is uſed in the compoſition of glaſs where the frit is prepared, it may be added to the alkaline ſalt and ſand when they are to be ground together, and calcined along with them, which will ſpare the trouble of the decripitation, mentioned p. 233, to be neceſſary. The ſalt muſt otherwiſe be put into a proper veſſel, and continued in a gentle heat till it ceaſes the crackling it will for ſome time make; and, if it be not uſed immediately, it muſt be carefully kept from all moiſture, even that of the air. When no frit is previouſly made ſo as to afford an opportunity of calcining the ſalt with it, being firſt decrepitated, it may be mixt with any of the other ingredients, but muſt not be ſuffered to attract any moiſture, otherwiſe it will crackle and decrepitate again in the pots, and waſte the matter, by diſſipating it with the numberleſs little exploſions it will make.

Magneſia, when admitted into the compoſition of glaſs made of frit without any other

 addition,

addition, being well levigated preparatorily, ſhould be intimately mixt by grinding with ſome pounds of the frit, and then put into the pots along with the reſt. But where lead, ſalt petre, or other ingredients are to be added, it may be mixt with them when they are ground, and then put to the frit. If no frit be prepared, it may nevertheleſs be mingled with any of the fluxing ingredients, and ſo commixt with the whole maſs.

SECTION II.

Of the manner of melting and fuſing the ſeveral compoſitions, in order to their converſion into glaſs, with the means of judging when the vitrification is perfect.

THE materials being all prepared and duly mixt, the matter muſt be put into the pots, and urged to fuſion, by a heat proportioned to the ſtrength of the flux in the compoſition; and this muſt be continued till the whole maſs become one uniform fluid, and have acquired the qualities neceſſary in that particular kind of glaſs which is intended to be produced. There is an attention to another object, however, required in the meantime, which is, the taking off the ſcum and foulneſs

foulneſs that will ariſe on the glaſs in the action of the ingredients on each other, and the coction of the matter. This is to be done by means of proper ladles, and ſhould be effectually performed before the glaſs be wrought; otherwiſe it will be ſo fouled by this ſubſtance, as to be rendered of very little value. This mattter is called *ſandover*; and is ſold to the colourmen, who diſpoſe of it to the potters, and they uſe it in the compoſitions of their glazings.

The exact time for keeping the ſeveral compoſitions of glaſs in fuſion, in order to their perfect vitrification, can by no means be ſettled by rule. For there is ſo much variation in the diſpoſition of different parcels of materials of the ſame kind to vitrify, and likewiſe ſo great an uncertainty, with reſpect to the degrees of heat maintainable even in the ſame furnace, that it muſt be left to the judgment of the operator. But where the power of the flux is weaker, as may be gathered from the nature and proportions of the ingredients in the compoſition, or where the heat is leſs intenſe, a greater time will neceſſarily be required than in the caſe of ſtronger fluxes, and briſker fires. No damage can, however, accrue from allowing a longer fuſion than may be neceſſary to give the glaſs the appearance of being perfect, except the loſs of time and conſumption of fuel; for with reſpect to the white tranſparent glaſs, it is always improved in its hardneſs and clearneſs by a longer coction.

In order to examine whether the glaſs have attained to its due ſtate of vitrification, an iron rod, of which the end ſhould be bright, or at leaſt intirely free from ruſt, muſt be dipt in the melted matter; and what adheres to it ſhould be firſt tried, with reſpect to its ductility or readineſs to ſuffer itſelf to be drawn out in long threads; and, if this quality be found in it to a ſufficient degree, being ſuffered to cool, it ſhould be carefully inſpected, to form a judgment of its colour and clearneſs. If it be tranſparent, colourleſs, and free from all ſpecks and bubbles, it may be concluded perfect, and fit to be wrought. But if it want theſe marks, more time muſt be given, according to the degree of the defectiveneſs; and, after a reaſonable allowance of ſuch time, it muſt be examined again by the ſame means; and, if not yet perfect, a further time muſt be given, and then the ſame trial made again. If, nevertheleſs, after all reaſonable allowance of time, and the application of a ſtrong heat, which ſhould be raiſed as high as can be admitted conveniently, without detriment to the other operations that may be carrying on in the ſame furnace, the glaſs yet appear faulty, the means, below adviſed, muſt be called in aid, in order to remedy the defects, either in the materials themſelves, or the means of their compoſition.

SECT.

SECTION III.

Of the means of promoting and accelerating the perfect vitrification of the ingredients, when the composition proves defective in that point; with the means of removing any yellowish or greenish tinge that may arise.

IF, after the treatment above advised, sufficient time and heat having been given, according to the nature of the composition, the glass will not be brought to run into one equal fluid mass, but appear yet turbid and milky, or to abound in bubbles after some abatement of the fire, it must be concluded that the flux is too weak. An additional quantity of the fluxing ingredients, mixt together in the same relative proportion as at first, must be therefore put into the pot to the melted mass, but gradually, lest any sudden ebullition may swell the matter, and force it out of the pot. The proportion of the whole of this additional quantity must be regulated by the appearance of what may be wanted from the backwardness of the vitrification in the glass; but it is better to try a smaller quantity first, because more may easily be added, if found necessary, and an excess, on the other hand, injures the qualities of the glass, and in the case of salts cannot

cannot be rectified, unleſs by a long continuance of the fuſion. There is, moreover, this further reaſon for trying only a ſmaller quantity at firſt, that frequently much leſs will anſwer the end than the appearance may ſeem to make neceſſary.

It is the practice of ſome, when the vitrification will not go forwards, to have recourſe to the following expedient. They take four, or perhaps ſix ounces of arſenic, and mix with it an ounce of magneſia, and, wrapping them tightly in a piece of paper of ſeveral doubles, they faſten the maſs to the end of their iron, and plunge it down to the bottom of the pot, where, the ſubſtance of the paper being deſtroyed, the matter is left. This will frequently ſucceed, and the glaſs will grow clear firſt towards the bottom, and ſoon after quite to the top, and gain the perfect ſtate of vitrification. The magneſia, nevertheleſs, however it may promote the fuſing power of the arſenic, does not ſeem a very proper ingredient in all caſes; for where there is no yellow tinge in the glaſs, it will neceſſarily impart a purpliſh caſt, which, though perhaps in too ſlight a degree to be eaſily diſtinguiſhed on a common inſpection, is nevertheleſs an imperfection, and would ſhew itſelf if the glaſs were to be compared with ſuch as was abſolutely colourleſs. I ſhould think it therefore better to join two or three ounces of calcined borax with the arſenic, which would anſwer the end without any kind of injury to the glaſs, and

and would not greatly enhance the expence, when it is premiſed how conſiderable a return a pot of glaſs makes when worked off.

When the glaſs appears perfect in other reſpects, but is found to have a green or yellow tinge, ſuch tinge may frequently be diminiſhed by the addition of one or two pounds of nitre, if none, or but a ſmall proportion, have before been admitted into the compoſition. The nitre, in this caſe, ſhould be fluxed with ſome frit, or with ſome other glaſs of the ſame kind with that in the pot, before it be put to the other ingredients. This is requiſite in order that it may the readier mix with the matter, and not to be partly blown out of the pot by the ebullition it would make in conſequence of the water contained in its chryſtals, or partly ſwim on the ſurface, as would happen if it were put in crude, without being preparatorily heated or mixed with any other body. But if this fail, or remedy only in part the fault, recourſe muſt be had to the magneſia, to which may be advantageouſly added two or three ounces of arſenic, and they may be conveyed into the pot by the means above directed, which prevents the powders from floating on the ſurface of the melted matter, where the arſenic would ſoon ſublime away and take no effect.

CHAP.

CHAP. VI.

Of the compofition and treatment of the common bottle or green glafs.

THIS kind, excepting the beauty of colour and tranfparency, is the moft perfect glafs at prefent manufactured, and, with refpect to its utility, is alfo equal in importance to any other. It is formed of fand of any kind, fluxed by the afhes of burnt wood, or of any parts of vegetables. The afhes muft not have the falts extracted from them, but muft confift of them and the calcined earth of the vegetable fubftances whence they are produced. This earth, though when once feparated from the falts formed along with it in the incineration, it becomes abfolutely refractory to vitrification, and refifts not only the fame falts which were taken from it, but even the ftrongeft fluxes, yet conjoined with thefe falts, in the manner in which it is originally produced in the incineration, it not only vitrifies perfectly itfelf, but even acts as a flux on fand; for on the mixing fand with the entire afhes, a much greater proportion will be converted into glafs than would be by the proportion of falts contained in the afhes if ufed alone without the earth. In general, the bottle-glafs is only compounded of thefe two ingredients, fand and wood-afhes; but where

where the ſcoria or clinkers of furnaces or forges can be obtained in ſufficient quantity, they may be added with great advantage, as a much leſs proportion of wood-aſhes will become neceſſary, and the good qualities of the glaſs be rather improved than impaired. The ſcoria to be obtained at large foundaries are very proper for the purpoſe, or thoſe from any other ſuch works where large and ſtrong fires are uſed. The particular compoſition of this glaſs may be as follows, but the proportions here given ſuppoſe the ſofteſt ſand, to procure which care ſhould be taken, as a great ſaving is thence made in the quantity of wood-aſhes neceſſary.

Compoſition of green or bottle-glaſs.

"Take of wood-aſhes two hundred pounds, "and of ſand one hundred pounds. Mix "them thoroughly well by grinding together."

This is the due proportion where the ſand is good, and the wood-aſhes are uſed without any other addition; but there are inſtances of ſand of ſo kindly a nature for vitrification that a greater proportion of it may be added.

Compoſition of green or bottle-glaſs with the addition of ſcoria or clinkers.

"Take of wood-aſhes one hundred and "ſeventy pounds, of ſand one hundred pounds, "and of ſcoria or clinkers fifty pounds. Mix "the whole well by grinding them together."

The

The clinkers ſhould be well ground before they be uſed, if they admit of it; but frequently they are too hard, and in that caſe they ſhould be broken into as ſmall bits as can be done conveniently, and mixt with the other matter without any grinding. The harder they are, the leſs material will be the powdering them, as they will the ſooner melt of themſelves in the furnace, and conſequently mix with the other ingredients.

The general manner of fuſing and converting this compoſition to glaſs is the ſame as in the other kinds, as are alſo the means of judging when the vitrification is perfect, and the remedy of the defect when the firſt compoſition will not produce it, except with reſpect to colour, which is, in the caſe of this kind of glaſs, intirely out of queſtion. When clinkers are not to be had in ſufficient quantity to allow of their being uſed in the general compoſition, it is well however to have ſome quantity to employ occaſionally when the vitrification fails; for the adding ſuch a proportion of them as may appear neceſſary, with an equal part of wood-aſhes, will anſwer the purpoſe much better than the addition of more wood-aſhes alone, where the flux is found too weak, as will happen ſometimes from the great variation in the different parcels, as well of the aſhes as ſand.

CHAP.

CHAP. VII.

Of coloured glaſs.

SECTION I.

Of the general nature of coloured glaſs, and of the ſeveral compoſitions proper for receiving the colours, in order to the forming glaſs, or paſtes, *in imitation of precious ſtones, with the qualities attendant on each.*

THE glaſs which is intentionally tinged with colours, may be divided into three kinds; the *white opake* and *ſemi-tranſparent glaſs*; the *tranſparent coloured glaſs*; and the *ſemi-tranſparent* or *opake coloured glaſs*.

The *white opake glaſs*, as alſo ſome tranſparent kinds, are principally uſed for making ſmall vaſes, toys, and ſome ſorts of uſeful veſſels, as cream pots, &c. in imitation of China-ware of any kind, of which we ſhall ſpeak below. It is alſo frequently employed as a white enamel for grounds, by painters of enamel dial-plates, ſnuff-boxes, and other ſuch pieces as have not occaſion to paſs ſeveral times through the fire in order to their being finiſhed.

The

The compoſition of white opake and ſemi-tranſparent glaſs is very various, as any kind of colourleſs glaſs may be made the body of ſuch, and the tinge may be given by calcined tin or antimony, alſo by arſenic, calcined hartſhorn or bones, and ſeveral other ſubſtances.

The *tranſparent glaſs*, *tinged with colours*, is likewiſe of different kinds, as the body or ground may be tranſparent colourleſs glaſs of any of the compoſitions above exhibited. But it is commonly diſtinguiſhed into two ſorts only, the one called *coloured glaſs*, and the other *paſtes*; the reaſon of which diſtinction lies in this. The chief deſign of all coloured tranſparent glaſs being the imitation of precious ſtones, the qualities of ſuch glaſs, when perfect, are to be very clear and tranſparent; to be free from all colour but the proper tinge, and to be very hard and tenacious in their texture. But theſe qualities being not to be had, except in glaſs that is very difficult to be melted, and requires a long as well as an intenſe heat, both to its own mature vitrification and that of the bodies added to give the colour to it, it became inconvenient to thoſe who prepared theſe kind of compoſitions in ſmall quantities to maintain ſuch ſtrong fires, and therefore ſofter compoſitions were ſought for, that would run with the heat of common ſmall furnaces, and would likewiſe be brought to perfection in a much ſhorter time. Theſe compoſitions were therefore called *paſtes*, to diſtinguiſh them from the harder glaſs, which retained its proper appellation.

The

The glaſs moſt proper for the imitation of precious ſtones, where the hardneſs, which is a moſt valuable quality in ſuch as is intended for mock jewels, that are expoſed to much wear, is wanted, is a perfect glaſs of ſalts, in which no more flux is admitted than merely what may be neceſſary for the complete vitrification of the glaſs and tinging ſubſtances; but it ſhould be abſolutely free from every kind of tinge, except that which is intended to be given it.

The kind moſt proper for forming paſtes is a mixt glaſs of lead and ſalts, which will run eaſily and vitrify, in a ſhort time, the metalline or other bodies that are employed for tinging it. But in order to make it yet more fuſible, without having ſo large a proportion of lead as may make the texture of the glaſs too tender and brittle, arſenic and borax may be admitted into the compoſition. Beſides the forming imitations of coloured ſtones, there is yet another purpoſe to which this kind of glaſs is peculiarly adapted, which is the making mock diamonds and topazes, that cannot be ſo well counterfeited by any other compoſition, as the lead, according to what was before obſerved, gives a very extraordinary refracting power to the glaſs, of which it is an ingredient. This ſort might ſeem to belong to the claſs of the white tranſparent kinds of glaſs before treated of; but as the application of that kind of compoſition, which renders it properly a paſte

according to the above diſtinction is confined to the intentions of imitating gems, it is more properly introduced amongſt the others with which it has a common denomination.

The ſemi-tranſparent coloured glaſs may have for its body either the compoſitions of the harder kinds, or thoſe of paſtes, and it is principally applied to the imitation of the ſemi-tranſparent ſtones, as *lapis lazuli*, chalcedony, jaſper, agate, opal, or ſuch others. The manner of compoſing them is much the ſame as that of the tranſparent kinds, except the adding ſome opake white body, which will endure the fuſion of the glaſs without being vitrified, at leaſt long enough to ſuffer it to be worked into the proper form. But the management of thoſe of this kind, which are compounded of a variety of colours, is much more difficult than that of the tranſparent ſorts, which is moſt probably the reaſon why they are ſo little in uſe, though ſome of them have a very beautiful effect for purpoſes they might be equally well applied to with the genuine ſtones.

SECTION II.

Of the nature and preparation of the ſubſtance uſed for tinging glaſs.

THE ſubſtances employed for tinging glaſs are, for the moſt part, metallic

and other foſſile bodies; or indeed all are ſo, except tartar, which has been added to ſome compoſitions. The metals themſelves make the principal part, and, properly treated, will produce all the colours, except a perfect blue. But for cheapneſs and expedience, the ſemi-metals, and preparations from other foſſile bodies, are ſometimes admitted in the place of them, particularly with reſpect to yellow, where antimony ſupplies the place of ſilver.

The ſubſtances that have been uſed for producing an opake whiteneſs in glaſs, are calcined tin, (commonly called putty) calcined antimony, arſenic, calcined horns or bones, and ſometimes common ſalt.

The ſubſtances employed for red, are gold, iron, copper, magneſia, and antimony.

The ſubſtances employed for blue, are zaffer and copper.

The ſubſtances that have been employed for yellow, are ſilver, iron, antimony, and magneſia, with tartar.

The ſubſtances employed for greens, are copper, Bohemian granata, and thoſe which will produce yellow or blue.

The ſubſtances employed for purple, are all ſuch as will produce red and blue.

The ſubſtances employed for orange colour, are antimony, and all thoſe which will produce red and yellow.

The ſubſtances employed for black, are zaffer, magneſia, copper and iron in various combinations.

The particular nature and preparation of several of these substances having been before given in the first volume of this work, I shall avoid repeating them here, and only refer to the pages where what relates to them is to be found. The preparation of calcined tin is to be found in page 283;—of calcined antimony 285;—of gold 289;—of silver 294;—of copper 295;—of iron 299. The nature of zaffer is explained 287;—of arsenic as a white colorific 285;—magnesia 287;—of antimony as a yellow 302;—of antimony vitrified into a red glass 303;— and of tartar 321.

The Bohemian granata requires no other preparation than to be well pulverized.

SECTION III.

Composition of hard glass and pastes proper for receiving colours.

THOUGH almost every kind of transparent colourless glass will admit of being tinged, yet there are, as was observed before, some compositions that are more peculiarly adapted to the purposes for which the coloured glass is intended, either by their hardness and tenacious texture, or their being more easy to be wrought by those who manufacture them, from their requiring less heat to fuse them, and fluxing the colorific matter expeditiously. The clearness and transparency of the glass, and the

the being devoid of any colour but that intended to be given, are likewiſe neceſſary in both the hard glaſs and paſtes which are to be coloured; and therefore to have them in perfection, a glaſs of each kind ſhould be purpoſely prepared, in which more exact methods may be uſed for producing theſe qualities, than are expediently compatible with the diſpatch and profit of groſſer manufactures. The beſt compoſitions for the hard glaſs are as follow; but as the extreme purity of the fixt alkaline ſalts is of very great conſequence in this caſe, it may not be improper to give previouſly the method of producing it.

Method of bringing pearl-aſhes, or any other fixt alkaline ſalt of vegetables, to the higheſt degree of purity, proper for the moſt tranſparent glaſs.

"Take of the beſt pearl-aſhes three pounds, "and of ſalt petre ſix ounces. Pound them "together in a glaſs or marble mortar till they "are thoroughly well mixt, and then put "part of them into a large crucible, and ſet it "in a furnace, where it may undergo a ſtrong "heat. When the part of the matter that "was firſt put into the crucible is heated red "hot, throw in the reſt gradually, and if "the crucible will not contain the whole, "pour part of the melted matter out on a "moiſtened ſtone, or marble; and, having "made room in the crucible, put in the reſt, "and let it continue there likewiſe till it be

"red hot. Pour it out then as the other, "and afterwards put the whole into an earthen, or very clean iron pot, with ten pints of "water, and heat it over the fire, till the falts "be intirely melted. Let it then, being "taken off the fire, ftand till it be cold, and "afterwards filter it through paper in one of "the pewter cullenders defcribed p. 28 in "the firft volume of this work. When it is "filtered, return the fluid again into the pot, "and evaporate the falt to drynefs, which "will then be as white as fnow, the nitre "having burnt all the phlogiftic matter that "remained in the pearl-afhes after their for-"mer calcination."

N° 1. *Compofition of the beft and hardeft glafs for receiving colours.*

"Take of the beft fand, cleanfed by wafh-"ing as directed in p. 233, twelve pounds, of "pearl-afhes, or fixt alkaline falt purified "with nitre as above, feven pounds, of falt "petre one pound, and of borax half a "pound."

The fand being firft reduced to powder in a glafs or flint mortar, the other ingredients fhould be put to it, and the whole well mixt by pounding them together.

N°. 2. *Compofition of the beft glafs for receiving colours, but fomewhat lefs hard than the above.*

"Take of the white fand cleanfed twelve "pounds, of pearl-afhes purified with falt petre,

"feven

" ſeven pounds, of nitre one pound, of borax
" half a pound, and of arſenic four ounces."

Proceed as in the laſt, but if the glaſs be deſired to melt with yet leſs heat, a pound of borax may be uſed inſtead of the half pound, and a pound of common ſalt may be added; but this laſt is apt to make the glaſs more brittle, which is an injury done to ſuch as is to be cut into very ſmall pieces, and ground with ſo many angles in the figure, as in the imitations of jewels.

No 3. *Compoſition of ſoft glaſs, or paſte, proper for receiving colours.*

" Take of white ſand cleanſed ſix pounds,
" of red lead three pounds, of purified pearl-
" aſhes two pounds, and of nitre one pound."

Proceed in the mixture as with the foregoing.

No 4. *Compoſition of glaſs, or paſte, much ſofter than the above.*

" Take of white ſand cleanſed ſix pounds,
" of red lead and purified pearl-aſhes, each
" three pounds, of nitre one pound, of borax
" half a pound, and of arſenic three ounces."

To be mixt as all the preceding.

This is very ſoft, and will fuſe with a very gentle heat, but requires ſome time to become clear, on account of the arſenic. It may even be prepared and tinged in a common fire without a furnace, if the pots containing it can be ſurrounded by burning coals, without danger

ger of their falling into it. The borax, being a more expenſive ingredient than the others, may be omitted where a ſomewhat greater heat can be applied, and the glaſs is not intended for very nice purpoſes, or a pound of common ſalt may be ſubſtituted in its place; but the glaſs will be more clear and perfect, and free itſelf much ſooner from bubbles where the borax is uſed.

This glaſs will be very ſoft, and will not bear much water if employed for rings, buckles, or ſuch imitations of ſtones as are expoſed to much rubbing. But for ear-rings, ornaments worn on the breaſt, or ſuch others as are but ſeldom put on, it may laſt a conſiderable time.

In all theſe ſoft compoſitions, care ſhould be taken that part of the ſand be not left unvitrified in the bottom of the pot, as will ſometimes happen; for, in that caſe, the glaſs, abounding too much with ſalts and lead, will not bear the air, but being coroded by it, will ſoon contract a miſtineſs and ſpecks on the ſurface, which will entirely efface all the luſtre of the paſte. An unlucky inſtance of this particular happened a few years ago, to the great loſs, and almoſt ruin of many of the poorer lapidaries; for there being at that time a great demand for all kinds of ornaments decorated with falſe ſtones for the Spaniſh Weſt-Indian trade, a perſon undertook to make them and furniſh the lapidaries, who glad of an opportunity of obtaining, on moderate terms, what they had found

found it difficult to procure before, (as the coloured glaſs had for the moſt part been imported from Venice) purchaſed as large quantities as they poſſibly could find money to pay for; but in a ſhort time, both the unwrought paſte, and that which they had been at the labour and expence of cutting, all turned foul, with a dull ſcum on the ſurface, and little ſpecks, which eat down into the ſubſtance, and took away the ſmoothneſs, as well as the luſtre. It is proper, therefore, for thoſe who prepare ſuch compoſitions, to be careful of adding more ſalts and lead than the proportions here given, and to watch that the ſand, or other matter employed for the body of the compoſition, be really fluxt. And it is equally proper, that they who purchaſe ſuch paſte, ſhould have ſome good ground of aſſurance of its being duly prepared, otherwiſe they may throw away their money in the purchaſe, their time in cutting, and their credit in diſpoſing of ſuch a faulty commodity.

There is a very certain and good method of preventing the inconvenience ariſing from the ſeparation of the ſalts in the preparation, as well of the hard kind of coloured glaſs as the paſtes, which is, by previouſly calcining the ſand, and fixt alkaline ſalts, as in the manner of making the frit. This may be done by putting the ſand and ſalt, reduced to powder, and mixt together, on a tile placed in a furnace of moderate heat, and turning over and ſtirring the matter with a tobacco-pipe, or

ſmall

ſmall iron rod; for which purpoſe, the tile ſhould be either placed near ſome proper opening into the furnace, or drawn to the door at due intervals. When the matter appears to coaleſce ſtrongly, and form a hard body on cooling, it may be taken out, and being kept intirely free from moiſture, ſhould be powdered. It ſhould be then added to the other materials, according to the proportion that would have been obſerved with regard to the ingredients of the frit, if they had been uſed without being combined previouſly by means of this operation.

SECTION IV.

Compoſition of glaſs, or paſte, of a red colour.

N° 1. *Compoſition of fine red glaſs reſembling the ruby.*

"TAKE of the hard glaſs, N° 1, or
" N° 2, one pound, of the *calx caſſii*,
" or gold prepared by precipitation with tin,
" in the manner directed p. 289 of the firſt
" volume of this work, three drams. Powder
" the glaſs, and grind the calx of gold after-
" wards with it in a glaſs, flint, or agate
" mortar, and then fuſe them together."

This may be made of a ſtronger or more diluted colour, by varying the proportion of the

the gold, in adjusting which properly, regard should be had to the application of the glass when made; for where this glass is set in rings, bracelets, or other close work where foils can be used, a great saving may be made with regard to the colour of it, without much injury to the effect; but for ear-rings, or other purposes where the work is set transparent, a full strong colour should be given, which may be effected by the proportions directed in this composition.

N° 2. *Composition of paste resembling the ruby.*

"Take of the paste, N° 3 or N° 4, one "pound, of *calx cassii*, or precipitation of "gold by tin, two drams. Proceed in the "mixture as with the above."

This will be equally beautiful with the above, and defective only in softness; but as that greatly takes away the value for some purposes, such as is appropriated to them may be tinged in a cheaper manner by the following means.

N° 3. *Composition of a cheaper paste resembling the ruby.*

"Take of the composition for paste, N° 3 "or N° 4, half a pound, of glass of antimony "half a pound, and of the precipitation of "gold by tin, one dram and a half. Proceed "as with the others."

This

This will be confiderably cheaper, and will have much the fame effect, execpt that it recedes more from the crimfon to the orange.

N° 4. *Compofition for hard glafs refembling the garnet.*

"Take of the compofitions for hard glafs, "N° 1 or N° 2, two pounds, of glafs of "antimony one pound, of magnefia, and "of the precipitate of gold by tin, each one "dram."

This compofition is very beautiful, but too expenfive, on account of the gold, for the imitation of garnets for common purpofes, on which account the following may be fubftituted.

N° 5. *Cheaper compofition of hard glafs refembling the garnet.*

"Take of the compofitions, N° 1 or 2, "two pounds, of the glafs of antimony two "pounds, and of magnefia two drams."

If the colour be found too dark and purple in either this or the preceding compofition, the proportion of magnefia muft be diminifhed.

N° 6. *Compofition of pafte of the colour of garnet.*

"Take of the compofitions for paftes, N° 1 or 2, and proceed as with the above."

N° 7. *Compoſition of hard glaſs reſembling the vinegar garnet.*

"Take of the compoſitions, N° 1 or N° 2, "two pounds, of glaſs of antimony one pound, "of iron, highly calcined, half an ounce. "Mix the iron with the uncoloured glaſs, and "fuſe them together till the maſs be per- "fectly tranſparent, then add the glaſs of "antimony powdered, ſtirring the mixture "with the end of a tobacco-pipe, and con- "tinue them in the heat till the whole be "perfectly incorporated."

N° 8. *Compoſition of paſte reſembling the vinegar garnet.*

"Take of the compoſition for paſte, N° 3 "or N° 4, and proceed as with the fore- "going."

In all the compoſitions given in this, and the ſucceeding ſections, it ſhould be obſerved, that ſome allowance may be made in the proportion of the colorific, or tinging matter, for the greater gravity of the paſtes than the hard glaſs, on the ſcore of the lead which enters into the compoſition; for, as the volume in a pound weight of paſte is conſequently leſs, a leſs quantity of tinging matter is proportionably neceſſary to give the ſame force of colour to it.

SECTION V.

Compoſition of glaſs and paſte of a blue colour.

N° 1. *Compoſition of hard glaſs of a very full blue colour.*

"TAKE of the compoſition for hard "glaſs, N° 1 or 2, ten pounds, of zaffer "ſix drams, and of magneſia two drams. "Proceed as with the above."

If this glaſs be of too deep a colour, the proportions of the zaffer and magneſia to the glaſs may be diminiſhed; and if it verge too much on the purple, to which caſt it will incline, the magneſia ſhould be omitted. If a very cool or pure blue be wanted, inſtead of the magneſia half an ounce of calcined copper may be uſed, and the proportion of zaffer diminiſhed by one half.

N° 2. *Compoſition of paſte of a full blue colour.*

"Take of the compoſition for paſte, N° 1 "or 2, ten pounds, and proceed as with the "foregoing."

N° 3. *Compoſition of hard glaſs reſembling the ſapphire.*

"Take of the compoſitions for hard glaſs, "N° 1 or N° 2, ten pounds, of zaffer three "drams and one ſcruple, of *calx caſſii*, or

"pre-

" precipitation of gold by tin, one dram.
" Proceed as with the above."

N° 4. *Cheaper composition of hard glass resembling the sapphire.*

" As the foregoing, only, instead of the " precipitate of gold, use two drams and two " scruples of magnesia."

If this be well managed, the colour will be very good, and the glass, when set and cut, will not be easily distinguishable from the true sapphire; but the preceding will be a finer colour, as there is a foulness in the tinge of the magnesia which will always diminish, in some degree, the effect of brighter colours when mixt with them.

N° 5. *Composition of paste resembling the sapphire.*

" Take of the composition for paste, N° 3 " or N° 4, and proceed as with the fore- " going."

It is not worth while to bestow the expence of colouring pastes with the gold, and it is therefore more expedient, in the case of such, to use the other method.

N° 6. *Composition of hard glass and pastes, resembling sapphires, by means of smalt.*

" Take of the compositions for hard glass " and pastes, any quantity, and mix with " them one-eighth of their weight of smalt, " the brightest and most inclining to purple " that can be procured."

If

If it be desired to give a more purple tinge, magnesia may be added in the proportion required.

N° 7. *Composition of hard glass resembling the eagle-marine, vulgarly called egg-marine.*

"Take of the composition for hard glass, "N° 1 or N° 2, ten pounds, of copper, "highly calcined with sulphur, in the manner "directed in the first volume of this work, "page 295, three ounces, and of zaffer one "scruple. Proceed as with the foregoing."

N° 8. *Composition of paste resembling the eagle-marine.*

"Take of the composition for paste, N° 1 "or 2, ten pounds, and proceed as with the "above."

SECTION VI.

Compositions of hard glass and pastes of a yellow colour.

N° 1. *Composition of hard glass of gold or full yellow colour.*

"TAKE of the compositions for hard "glass. N° 1 or N° 2, ten pounds, "but omit the salt petre, and for every pound "add an ounce of calcined borax, or, if that "do not render the glass sufficiently fusible, "two

" two ounces, of red tartar, the deepeſt co-
" loured that can be procured, ten ounces,
" of magneſia two ounces, of charcoal of
" ſallow, or any other ſoft kind, two drams.
" Proceed as with the reſt."

This colour may be prepared with ſilver, but as there is no advantage in that to counterbalance the expence, I wave giving the proceſs.

N° 2. *Compoſition of paſte of a gold or full yellow colour.*

" Take of the compoſition for paſte, N° 3
" or N° 4, prepared without the ſalt petre, ten
" pounds, of iron, ſtrongly calcined, as di-
" rected in the firſt volume of this work,
" p. 299, one ounce and a half. Proceed as
" with the others."

The crude tartar and the charcoal muſt not be uſed where lead enters into the compoſition of the glaſs, and the nitre may be ſpared, becauſe the yellow tinge given to the glaſs by the lead, on account of which the nitre is uſed, is no detriment in this caſe, but only adds to the proper colour. This colour may alſo be prepared by crude antimony, as well as the calcined iron, but it is more difficult to be managed, and not ſuperior in its effect.

N° 3. *Compoſition of hard glaſs reſembling the topaz.*

" Take of the compoſition for hard glaſs,
" N° 1 or N° 2, ten pounds, and an equal
" quantity of the gold coloured hard glaſs.
" Powder and fuſe them together."

 As

As there is a great variety in the colour of the topaz, ſome being a deeper yellow, and others ſlightly tinged, the proportions of the yellow glaſs to the white may be accordingly varied at pleaſure, that here given being for the deepeſt.

N° 4. *Compoſition of paſte reſembling the topaz.*

" This may be done in the ſame manner " as the preceding, but the ſalt petre may be " omitted in the original compoſition of the " glaſs; and for the reſemblance of the very " ſlightly coloured topazes, neither the gold " coloured paſte, nor any other tinging mat- " ter need be added, that of the lead being " ſufficient, when not deſtroyed by the nitre."

N° 5. *Compoſition of hard glaſs reſembling the chryſolite.*

" Take of the compoſition for hard glaſs, " N° 1. or N° 2, ten pounds, of calcined iron " ſix drams. Proceed as with the above."

N° 6. *Compoſition of paſte reſembling the chry-ſolite.*

" Take of the compoſition for paſte, N° 3 " or N° 4, prepared without ſalt petre, ten " pounds, and of calcined iron five drams. " Proceed as with the reſt."

SECT.

SECTION VII.

Composition of hard glass and paste of a green colour.

N° 1. *Composition of hard glass resembling the emerald.*

" TAKE of the composition for hard
" glass, N° 1 or N° 2, nine pounds, of
" copper, precipitated from *aqua fortis*, ac-
" cording to the directions given in the first
" volume of this work, p. 297, three ounces,
" and of precipitated iron two drams."

N° 2. *Composition of paste resembling the emerald.*

" Take of the composition for paste, N° 1
" or N° 2, and proceed as with the above;
" but if the salt petre be omitted in the pre-
" paration of the paste, a less proportion of
" the iron will serve."

SECTION VIII.

Compositions of glass and pastes of a purple colour.

N° 1. *Composition of hard glass of a deep and very bright purple colour.*

"TAKE of the composition for hard "glass, N° 1 or N° 2, ten pounds, of "zaffer six drams, of gold, precipitated by "tin, one dram. Proceed as with the rest."

N° 2. *Cheaper composition of hard glass of a deep purple colour.*

"Take of the compositions for hard glass, "N° 1 or N° 2, ten pounds, of magnesia "one ounce, and of zaffer half an ounce. "Proceed as with the others."

N° 3. *Composition of paste of a deep purple colour.*

"Take of the composition for pastes, N° 3 "or N° 4, ten pounds, and treat them as the "foregoing."

N° 4. *Composition of hard glass of the colour of the amethyst.*

"Take of the composition for hard glass, "N° 1 or N° 2, ten pounds, of magnesia one "ounce and a half, and of zaffer one dram. "Proceed as with the rest."

N° 5.

N° 5. *Composition of paste of the colour of the amethyst.*

"Take of the composition for paste, N° 1 "or N° 2, ten pounds, and treat it as the "preceding."

SECTION IX.

Of paste resembling the diamond.

"TAKE of the white sand six pounds, of "red lead four pounds, of pearl-ashes, "purified as above directed, three pounds, "of nitre two pounds, of arsenic five ounces, "and of magnesia one scruple. Proceed as "with the others, but continue the fusion for "a considerable time on account of the large "proportion of arsenic."

If this composition be thoroughly vitrified, and kept free from bubbles, it will be very white, and have a very great lustre; but, if on examination it yet appear to incline to yellow, another scruple or more of the magnesia may be added. It may be rendered harder by diminishing the proportion of lead, and increasing that of the salts, or fusing it with a very strong fire; but the diminution of the proportion of lead will make it have less of the lustre of the diamonds.

SECTION X.

Composition of hard glass and paste perfectly black.

Composition of hard glass perfectly black.

" TAKE of the composition for hard
" glass, N° 1 or N° 2, ten pounds, of
" zaffer one ounce, of magnesia, and of iron
" strongly calcined, each six drams. Proceed
" as with the rest."

Composition of paste perfectly black.

" Take of the composition for paste, N° 1
" or N° 2, prepared with the salt petre, ten
" pounds, of zaffer one ounce, of magnesia
" six drams, and of iron, highly calcined, five
" drams. Proceed as with the others."

SECTION XI.

Of the white opake and semi-transparent glass and pastes.

N° 1. *Composition of white opake glass.*

" TAKE of the composition for hard
" glass, N° 1 or N° 2, ten pounds, of
" horn, ivory, or bone, calcined perfectly white,
" one pound. Proceed as with the others."

N° 2.

N° 2. *Composition of paste of an opake whiteness.*

"Take of the composition, N° 3 or N° 4, "ten pounds, and make the same addition as "to the above."

N° 3. *Composition of glass of an opake whiteness formed by arsenic.*

"Take of flint-glass ten pounds, and of "very white arsenic one pound. Powder and "mix them thoroughly, by grinding them "together, and then fuse them with a mode-"rate heat till they be well incorporated, but "avoid liquefying them more than to make "a perfect union."

This glass has been made at a considerable work near London in great quantities, and has not only been manufactured into a variety of different kinds of vessels, but, being very white and fusible with a moderate heat, has been much used as a white ground for enamel in dial-plates, snuff-boxes, and other pieces which have not occasion to go several times into the fire to be finished. It will not, however, bear repeated burnings, nor a strong heat continued for any length of time, when applied to this purpose, without becoming transparent, to which likewise the smoke of a coal fire will also greatly contribute; but it answers the end very well in many cases, though even in those, enamel of the same degree of whiteness would be preferable, as this is always brittle, and of less firm and tenacious texture.

N° 4. *Composition of hard glass, or paste, formed by calx of tin or antimony.*

"Take of any of the compositions for hard "glass, or pastes, ten pounds, of calcined tin, "(commonly called putty) or of antimony, "or tin calcined by means of nitre, as directed "in p. 283 of the first volume of this work, "one pound and a half; mix them well, by "grinding them together, and then fuse "them with a moderate heat."

The glass of this kind, made with the composition for pastes, differs in nothing from white enamel but in the proportion of the calx of tin and antimony; and if those calces be prepared with nitre, (without which they cannot be made to produce a pure whiteness in glass) this composition will be more expence and trouble than those above given, without any other advantage than that it will bear the action of a much stronger and longer continued fire, without losing its opacity in any degree than the others.

N° 5. *Composition of semi-transparent white glass and paste, resembling the opal.*

"Take of any of the compositions for hard "glass, or paste, ten pounds, of horn, bone, "or ivory, calcined to a perfect whiteness, half "a pound. Proceed as with the rest."

This white hard glass is much the same with the German glass formerly brought here in poringers, cream-pots, vinegar-cruets, and other

other ſuch pieces, of which we frequently meet with the remains.

SECTION XII.

Compoſition of coloured, opake, and ſemi-tranſparent glaſs.

Compoſition of fictitious or counterfeit lapis lazuli.

"TAKE of any of the above compoſitions for hard glaſs, or paſte, ten pounds, of calcined bones, horn, or ivory, three quarters of a pound, of zaffer one ounce and a half, and of magneſia half an ounce. Fuſe the uncoloured compoſition with the zaffer and magneſia till a very deep tranſparent blue glaſs be produced. The maſs being cold, powder it, and mix it with the calcined matter, by grinding them together. After which, fuſe them with a moderate heat till they appear to be thoroughly incorporated, and then form the melted maſs into cakes, by pouring it on a clean bright plate of copper or iron."

If it be deſired to have it veined with gold, it may be done by mixing the gold powder prepared according to the directions given in the firſt volume of this work, p. 440, with an equal weight of calcined borax, and tempering them with oil of ſpike, by which mixture, the

the cakes, being painted with ſuch veins as are deſired, they muſt be put into a furnace of a moderate heat, and the gold will be cemented to the glaſs as firmly as if the veins had been natural.

If the counterfeit *lapis lazuli* be deſired of a lighter hue, the quantity of zaffer and magneſia muſt be diminiſhed; or, if it be required to be more tranſparent, that of the calcined horn, bone, or ivory, ſhould be leſſened.

Inſtead of zaffer, where that cannot be obtained, a proper proportion of ſmalt may be ſubſtituted. And in all caſes, indeed, it may be a more certain way to form the zaffer and vitrifying ingredients into glaſs alone, and then, having powdered them with the calcined bones or horns, infuſe them a ſecond time, and make them into cakes in the manner directed; for the fluxing power of the ingredients of the glaſs is ſo retarded by the calcined bone or horn, that it may, in ſome caſes, fail to act ſufficiently on the zaffer to vitrify it perfectly.

Compoſition of hard glaſs reſembling the red cornelian.

" Take of the compoſitions for hard glaſs, " N° 1, or N° 2, two pounds, of glaſs of " antimony one pound, of the calcined vi- " triol, called ſcarlet oker, prepared as di- " rected p. 51 of the firſt volume of this " work,

" work, two ounces, and of magnesia one " dram.

" Fuse the glass of antimony and magnesia " with the other glass first together, and " then powder them well, and mix them " with the scarlet oker, by grinding them " together, and afterwards fuse the mixture " with a gentle heat, till they be incorpo- " rated; but the heat must not be continued " longer than is absolutely required to form " them into a vitreous mass."

If it be desired to have the composition more transparent, a proportionable part of the red oker must be omitted.

Composition of paste resembling the red cornelian.

" Take of the compositions for pastes, " No 1, or N° 2, two pounds, and proceed " as with the above."

Composition of hard glass resembling the white cornelian.

" Take of the compositions for hard glass, " N° 1, or N° 2, two pounds, of yellow " oker, well washed, two drams, and of " calcined bones, each one ounce. Mix them " well by grinding them together, and fuse " them with a gentle heat, till the several " ingredients be well incorporated in a vi- " treous mass."

Composition

Compoſition of paſte reſembling the white cornelian.

" Take of the compoſition for paſtes, N° 1 " or N° 2, two pounds, and proceed as with " the foregoing."

Compoſition of hard glaſs, or paſte, reſembling the turquoiſe ſtone.

" Take of the compoſitions for blue glaſs, " or paſte, N° 7 or N° 8, (being thoſe re- " ſembling the eagle marine) ten pounds, of " calcined bone, horn, or ivory, half a pound. " Powder and mix them well, and then fuſe " them in a moderate heat till they be tho- " roughly incorporated."

If the colour be not ſo deep as may be deſired, a ſmall proportion of ſmalt may be added.

Compoſition of the brown Venetian glaſs with gold ſpangles, commonly called the Philoſopher's ſtone.

" Take of the compoſition for hard glaſs, " N° 2, and the compoſition for paſte, N° 1, " each five pounds, and of highly calcined " iron one ounce. Mix them well, and fuſe " them till the iron be perfectly vitrified, and " have tinged the glaſs of a deep tranſparent " yellow brown colour. Powder this glaſs, " and add to it two pounds of glaſs of anti- " mony, being powdered, and mix them " well, by grinding them together. Take

" part

" part of this mixture, and rub into it four-
" ſcore or one hundred leaves of the counter-
" feit leaf gold, commonly called *Dutch gold*;
" and, when the parts of the gold ſeem ſuf-
" ficiently divided, mix the powder contain-
" ing it with the other part of the glaſs.
" Fuſe the whole then with a moderate
" heat, till the powder run into a vitreous
" maſs fit to be wrought into any of the
" figures, or veſſels, into which it is uſually
" formed; but avoid a perfect liquefaction,
" becauſe that deſtroys, in a ſhort time, the
" equal diffuſion of the ſpangles, and vitri-
" fies, at leaſt part, the matter of which they
" are compoſed, converting the whole to a
" kind of tranſparent olive coloured glaſs."

This kind of glaſs is uſed for a great variety of toys and ornaments with us, who, at preſent procure it from the Venetians; and a few years ago a very great demand aroſe for it to China, and raiſed the price very high, till ſuch quantities had been brought from Venice and ſent thither as glutted the market. But there is no reaſon why it ſhould not be equally well prepared here, and at a ſmall expence, as will be found on a few trials, by thoſe who will carefully execute what is here directed.

CHAP.

CHAP. VIII.

Of the fuſion and vitrification of the ſeveral compoſitions of coloured glaſs, with the particular rules and cautions to be obſerved in the management of each kind.

THE ſeveral compoſitions above-mentioned being prepared according to the directions reſpectively given, the matter ſhould be put into proper pots, ſuch as are deſcribed p. 255, of which it ſhould not fill above two-thirds; and then placed in the furnace, of which the conſtruction is given p. 252, or in any other kind, where they may receive a ſufficient heat, and be ſecured from any coals, ſoot, or any other filth falling into them; in order to prevent which, it is expedient, with regard to the pots in which this kind of glaſs is prepared, to have covers over the tops of them, with a little return over the ſide. And it is alſo proper to have a hole in the ſide a little below the return, through which an iron may be paſſed to take out a ſmall quantity of the melted matter, for the judging of the progreſs of the vitrification. Theſe pots, when put into the furnace above-mentioned, ſhould be placed on the flooring or ſtage intended to ſupport them in the part betwixt the doors, oppoſite

oppoſite to that through which they are paſſed into the furnace, according to the manner before directed, which ſhould be done by means of a ſtrong iron peel, like thoſe uſed by the bakers. It is neceſſary to obſerve, likewiſe, that however well the pots may have been before baked, it is always proper, in the caſe of glaſs of greater value, where the clearneſs and beauty is of conſequence, to give them another burning before they be uſed, and, at the ſame time, to encruſt them over with any common colourleſs glaſs, which may be done in this manner. Having reduced the glaſs to powder, moiſten all the inſide of the pot with water; and, while it is yet moiſt, put in ſome of the powdered glaſs, and ſhake it about till the whole inner ſurface of the pot be covered by what will adhere to it in conſequence of the moiſture. Throw out then the redundant part of the powdered glaſs, and the pot being dry, ſet in a furnace ſufficiently hot to vitrify the glaſs adhering to it, and let it continue there ſome time; after which, care muſt be taken to let it cool gradually.

The pots containing the compoſition being thus placed in the furnace, a gentle heat, ſuch as will juſt keep the pots red hot, ſhould be given for the firſt hour or longer. There is, however, an exception to this, which is, where there is much arſenic in the compoſition, which requires that ſome degree of vitrification ſhould be brought on as quickly as poſſible, in order to fix it, and prevent its ſub-

liming

liming away from the other ingredients, which it will not ceafe to do fo long as continued in the ftate of a powder. But where a gentler heat is proper at firft, after the expiration of an hour and a half, or two hours at furtheft, the heat may be raifed fufficiently to produce a vitrification, but not fo as to render the melted matter very fluid at firft, which in this part of the procefs would occafion a feparation of the ingredients, and greatly retard, if not intirely prevent, the perfect vitrific incorporation of the whole.

The due degree or continuance of heat, for the perfecting thefe kinds of glafs, cannot be fettled by any ftandard, as they are varied both by the nature of the compofition and the quantity of the matter. But in the cafe of pots which hold ten or eleven pounds, twenty or twenty-four hours may be allowed for hard glafs, and fourteen or fixteen for paftes. And where much arfenic enters into the compofition, though it is neceffary to bring on a quicker vitrification, yet more time muft fometimes be given to the matter than in other cafes, before all the cloudinefs be diffipated.

In the fufion of the tranfparent coloured glafs, it is above all things neceffary to avoid ftirring the matter, or even fhaking the pots, as it would otherwife hazard the caufing bubbles in the glafs, to prevent which is the greateft difficulty attending the preparation of counterfeit gems. But if the ingredients, by their action on each other, do yet, notwith-

ftanding

ſtanding all exterior concuſſion be avoided, produce bubbles, the glaſs muſt be continued in fuſion till they wholly vaniſh. And if, when bubbles do ariſe in the glaſs, and time be given for it, there appear no tendency to their going away, the heat muſt be gradually raiſed to a greater pitch, that the glaſs may be rendered more fluid, and that viſcidity, which was the occaſion of their detention, removed.

When a proper time has been given the glaſs to attain to a perfect ſtate of vitrifaction, it ſhould be examined, by putting the ſmall end of a tobacco-pipe to the ſurface of the glaſs, through the hole in the ſide of the pot; which will bring away with it a little quantity of the glaſs, from whence the qualities may be judged of. And if there appear any defects that ſeem owing to the want of a due converſion of the ingredients to a vitreous ſtate, more time and heat muſt be given to it; but if no ſuch defects are found, and the glaſs appear perfect, the fire ſhould be decreaſed, and, by degrees, ſuffered to go out; and the pots continued in the furnace till they become cold; after which, the pot ſhould be torn off from the maſs of glaſs contained in it. As, however, it is not always convenient to diſcontinue the heat of the furnace, when one or more pots of the glaſs may have attained to the due ſtate of vitrification, they may, on ſuch occaſions, be taken out; and if the glaſs be not of great value, nor intended for very

nice purpofes, it may be formed into cakes, by pouring it on a clean plate of iron or copper, or into rolls. Thefe cakes, or rolls, fhould be put into a moderate heat before they grow cold, and continued there for fome time, that they may gain a good temper, fo as to bear cutting or working in any way, according to the ufe they are intended for.

The tranfparent coloured glafs is in moft cafes improved by continuing it in the heat, even for a confiderable time after the vitrification feems perfected, as it is by that means rendered harder, and freer from fpecks and bubbles. But the femi-tranfparent kinds, and opake white formed of arfenic, muft be taken juft at the point when the ingredients are duly united; for a more mature vitrification converts to tranfparent glafs the whole, or part of thofe fubftances which fhould not be brought to that ftate. But as I have before intimated in what particular cafes this requires to be moft attended to, it is needlefs to enlarge further on the matter here.

CHAP. IX.

Of colouring rock chryftals for the imitation of gems.

THE far greater hardnefs of chryftal than of any kind of glafs, and the fuperior luftre of it to any but paftes, which are deplo-

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rably ſoft, have rendered the art of imparting to it the colours of gems an object of frequent and eager purſuit, as great advantages might probably have ariſen from it to the firſt inventors. There are two methods by which it has been conceived there was a poſſibility of doing it; the one by cementing, that is, impregnating the chryſtals by means of heat, with the proper tinging particles under the form of ſteam; the other by bringing the chryſtal to a ſtate of fuſion, through the means of heat aided by a ſtrong flux, and combining it in that ſtate with the proper colouring ſubſtances. Both of theſe have been pretended to be effected in a perfect manner, and very oſtentatious accounts of them have been given to the public; though it is much to be feared, that ſo far from having carried this art to any degree of perfection, there is not hitherto known one ſingle fact, or principle, that in the leaſt ſeems to lead to the attainment of it. As the world has been made to believe, however, as well more lately as formerly, by perſons of ſome authority, that both theſe methods have been practiſed with all the deſired ſucceſs, I will exhibit the particular manner in which each has been practiſed by thoſe who have been believed to be moſt the maſters of theſe arts.

"Take of very yellow orpiment and white "arſenic, each two ounces, and of antimony "and *ſal Ammoniacum*, each one ounce; and "having reduced them to powder, mix them

" well together, and put them into a large " crucible. Over this mixture lay the pieces of " rock chryſtal, firſt ſuch as are of the leaſt ſize, " then larger, and at the top the biggeſt, taking " care that thoſe choſen for this purpoſe have " no flaws nor foulneſs. This crucible muſt " then be covered by a leſſer turned upſide " down upon it, in the bottom of which there " ſhould be previouſly made a little opening " of the bigneſs of a pea, in order that this " bottom, becoming now the top of the " veſſel, formed by joining the two together, " the fumes of the matter contained may have " vent through the hole, and, conſequently, " being determined upwards, may paſs through " the chryſtals, and act upon them. The " joints produced by inverting the leſſer cru- " cible into the greater ſhould be luted, and " being dry, the veſſel thus formed muſt be " put in the midſt of pieces of charcoal, in " ſuch manner that the undermoſt crucible " may be buried in them intirely, and the " uppermoſt half way. The coals muſt then " be kindled, and the fire ſuffered to burn " very gradually without blowing, unleſs it " ſhould be neceſſary to keep it from extin- " guiſhing; to prevent which from happening " too ſoon, the pieces of charcoal ſhould be " choſen large. As the fire riſes, the mix- " ture in the crucible will emit copious fumes, " which being very noxious, muſt be care- " fully avoided; and to that end this opera- " tion ſhould be always performed under a

" chimney,

" chimney, the front of which ſhould be " brought ſo low that all the ſmoke may be " determined up it, and not ſpread itſelf in " the elaboratory, or other place. The fire " muſt be kept up ſo long as any of theſe " fumes appear to riſe, and then permitted " to go gradually out, and all acceſs of cold " air muſt be cautiouſly prevented. When " the crucibles are grown intirely cold, but " not before, the uppermoſt may be taken " off, and the chryſtal will be found co- " loured, ſome pieces like topazes, and " ſome like rubies, and a variety of other " ſtones."

It has been ſaid, that the chryſtals thus coloured have been cut, and produced fine imitations of the true ſtones; but the truth of the matter is, (notwithſtanding all pretenſion to more) that they do appear, when taken out of the crucible, to be well coloured and beautiful, yet on further examination it is found that the whole effect is produced by a fallacious cauſe; for the chryſtals being cracked by the heat, as is almoſt univerſally the conſequence of being expoſed to this degree of it, the fumes have inſinuated themſelves into theſe cracks, and there producing the ſame effect as the paint uſed betwixt the two tables of doublets, the whole ſubſtance of the ſtone has the appearance of being tinged. But on due inſpection, nevertheleſs, the chryſtals are found to be neither fit to be cut, on account of the flaws, nor to have ac-

quired any colour, but what would inſtantly be deſtroyed on the ſeparation of the ſeveral parts of the ſtones into which they are divided by the cracks, ſo that this method, together with many others of the ſame kind for giving colours to chryſtals by cementation, will be found to elude the hopes of thoſe who try them with any confidence.

The other pretended method of colouring chryſtals, by fuſing them, and imparting the various tinges to them, while in a melted ſtate, is thus performed.

" Take of rock chryſtals any quantity, and
" put them in a covered crucible in a ſtrong
" fire, where they muſt be continued for ſome
" time. Remove the crucible then out of the
" fire, and immediately throw the chryſtals
" into a veſſel of clean cold water; from
" whence being again collected, they muſt be
" re-calcined, and afterwards thrown into
" freſh water again in the ſame manner; and
" this operation muſt be repeated till the chry-
" ſtals be ſo changed in their texture, by the
" flaws and cracks produced by the ſudden
" change from heat to cold, that they may be
" eaſily levigated. Powder the chryſtals thus
" calcined; and, to three pounds of them,
" add two pounds of purified pearl-aſhes, or
" a pound and quarter of red lead, together
" with any of the tinging ſubſtances above-
" mentioned, in the proportion directed for
" colouring glaſs or paſtes, and fuſe them in
" the ſame manner alſo as has been before

" adviſed.

" advifed for other compofitions. If the matter be found too difficult to be brought to a vitreous ftate by this proportion of pearl-afhes or lead, borax or arfenic may be added, as in other cafes, in order to form a more powerful flux."

The chryftal, thus treated, produces however nothing more than a glafs exactly of the fame kind with that formed of the Lynn fand, which is in fact no other than a grofs powder of chryftal, and neither of them differ very effentially from fuch calcined flints as are wholly free from colour. The fuppofition therefore that the chryftal can be fufed by this means, and, being tinged while in that ftate, reduced afterwards to its original hardnefs, is wholly groundlefs; for it cannot be fufed by the heat of furnaces without the medium of fome fluxing body added to it, and then its texture and properties are fo changed, or rather the glafs produced by the compofition is fo different from the chryftal itfelf, that there does not appear to be the leaft advantage in employing rock chryftal in forming fuch a compofition preferably to flints, even if they could be procured at the fame expence, and required no greater trouble or labour in their ufe.

SECTION X.

Of doublets.

THE impracticability of imparting tinges to the body of chryſtals, while in their proper and natural ſtate, and the ſoftneſs of glaſs, which renders ornaments made of it greatly inferior in wear to chryſtal, gave inducements to the introduction of colouring the ſurface of chryſtal, wrought into a proper form in ſuch manner that the ſurfaces of two pieces ſo coloured being laid together, the effect might appear the ſame as if the whole ſubſtance of the chryſtal had been tinged. The chryſtals (and ſometimes white tranſparent glaſs) ſo treated, were called *doublets*, and at one time prevailed greatly in uſe, on account of the advantages, with reſpect to wear, ſuch doublets had, when made of chryſtal, over glaſs, and the brightneſs of the colours which could with certainty be given to counterfeit ſtones this way, when coloured glaſs could not be procured, or at leaſt not without a much greater expence. Doublets have not indeed the property which the others have of bearing to be ſet tranſparent, as is frequently required in drops of ear-rings and other ornaments. But when mounted in rings, or uſed in ſuch manner that the ſides of the pieces where the joint is made cannot be inſpected, they have,

when

when formed of chryftal, the title to a preference to the coloured glafs; and the art of managing them is therefore, in fome degree, of the fame importance with that of preparing glafs for the counterfeiting gems, and is therefore properly an appendix to it, as being intirely fubfervient to the fame intention. The manner of managing doublets is as follows.

Let the chryftal or glafs be firft cut by the lapidaries in the manner of a brilliant, except that, in this cafe, the figure muft be compofed from two feparate ftones, or parts of ftones, formed in the manner of the upper and under parts of a brilliant, if it was divided in an horizontal direction, a little lower than the middle. After the two plates of the intended ftone are thus cut, and fitted fo exactly that no divifion can appear when they are laid together, the upper part muft be polifhed ready for fetting, and then the colour muft be put betwixt the two plates by this method.

" Take of Venice or Cyprus turpentine two
" fcruples, and add to it one fcruple of the
" grains of maftic, chofen perfectly pure and
" free from foulnefs, and previoufly pow-
" dered. Melt them together in a fmall fil-
" ver or brafs fpoon ladle, or other veffel,
" and put to them gradually any of the co-
" loured fubftances below-mentioned, being
" firft well powdered, ftirring them together
" as the colour is put in, that they may be
" thoroughly commixt. Warm then the
" doublets

"doublets to the ſame degree of heat as the
"melted mixture, and paint the upper ſur-
"face of the lower part, and put the upper
"one inſtantly upon it, preſſing them to
"each other, but taking care that they may
"be conjoined in the moſt perfectly even
"manner. When the cement or paint is
"quite cold and ſet, the redundant part of
"it, which has been preſſed out of the joint
"of the two pieces, ſhould be gently ſcraped
"off the ſide, till there be no appearance of
"any colour on the outſide of the doublets;
"and they ſhould then be ſkilfully ſet, ob-
"ſerving to carry the mounting over the
"joint, that the upper piece may be well
"ſecured from ſeparating from the under
"one."

The colour of the ruby may be beſt imitated by mixing a fourth part of carmine with ſome of the fineſt crimſon lake that can be procured; which may be beſt made for this purpoſe of Brazil wood, by the proceſs given in p. 64 of the firſt volume of this work.

The ſapphire may be counterfeited by very bright Pruſſian blue, mixt with a little of the above-mentioned crimſon lake, to give it a caſt of the purple. The Pruſſian blue ſhould not be very deep coloured, or but little of it ſhould be uſed; for otherwiſe, it will give a black ſhade that will be injurious to the luſtre of the doublets.

The emerald may be well counterfeited by diſtilled verdigriſe, with a little powdered aloes;

but

but the mixture ſhould not be ſtrongly heated, nor kept long over the fire after the verdigriſe is added, for the colóur is apt to be ſoon impaired by it.

The reſemblance of the garnet may be made by dragon's blood; which, if it cannot be procured of ſufficient brightneſs, may be helped by a very ſmall quantity of carmine.

The vinegar garnet may be imitated with great ſucceſs by the orange lake, for which the proceſs is given in the firſt volume of this work, page 119.

The amethyſt may be counterfeited by the mixture of ſome Pruſſian blue with the crimſon lake; but the proportions can only be regulated by diſcretion, as different parcels of the lake and Pruſſian blue vary extremely in the degree of ſtrength of the colour.

The yellow topazes may be imitated by mixing the powdered aloes with a little dragon's blood, or by good Spaniſh anatto; but the colour muſt be very ſparingly uſed, or the tinge will be too ſtrong for the appearance of that ſtone.

The chryſolite, hyacinth, vinegar garnet, eagle marine, and other ſuch weaker or more diluted colours, may be formed in the ſame manner, by leſſening the proportions of the colours, or by compounding them together correſpondently to the hue of the ſtone to be imitated; to which end it is proper to have an original ſtone, or an exact imitation of one at hand, when the mixture is made, in order to

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the more certain adapting the colours to the effect desired. When these precautions are taken, and the operation well conducted, it is practicable to bring the doublets to so near a resemblance of the true stones that even the best judges cannot distinguish them, when well set, without a peculiar manner of inspection.

Where any kind of lake or Prussian blue is used for this purpose, it is best to grind or levigate it with spirit of turpentine instead of water, which will prevent its concreting again as it dries. The dragon's blood may be levigated with water, but the distilled verdigrise must be powdered dry. All the substances used as tinges for doublets or foils must, however, be powdered as finely as possible, the brightness of the counterfeit stones for which they are used depending very greatly on that.

There is however an easy method of distinguishing doublets; which is only to hold them betwixt the eye and light in such position that the light may pass through the upper part and corners of the stone, which will then shew such parts to be white, and that there is no colour in the body of the stone.

CHAP. XI.

Of foils.

SECT. I. *Of the general nature and preparation of foils.*

FOILS are thin plates or leaves of metal that are put under ſtones, or compoſitions in imitation of ſtones, when they are ſet.

The intention of foils is either to increaſe the luſtre or play of the ſtones, or more generally to improve the colour, by giving an additional force to the tinge, whether it be natural or artificial, by that of a ground of the ſame hue, which the foil is in this caſe made to be.

There are conſequently two kinds of foils; the one is colourleſs, where the effect of giving luſtre or play to the ſtone is produced by the poliſh of the ſurface, which makes it act as a mirror, and, by reflecting the light, prevent that deadneſs which attends the having a duller ground under the ſtone, and brings it by the double refraction of the light that is cauſed, nearer to the effect of the diamond. The other is coloured with ſome pigment or ſtain of the ſame hue as the ſtone, or of ſome other which is intended to modify and change the hue of the ſtone in ſome degree; as, where a yellow foil may be put under green, which is too much

much inclining to the blue, or under crimſon, where it is deſired to have the appearance more orange or ſcarlet.

Foils may be made of copper or tin; and ſilver has been ſometimes uſed, with which it has been adviſed, for ſome purpoſes, to mix gold, but the expence of either is needleſs, as copper may be made to anſwer the ſame end.

Where coloured foils are wanted, copper may therefore be beſt uſed, and may be prepared for the purpoſe by the following means.

" Take copper-plates beaten to a proper " thickneſs, and paſs them betwixt a pair of " fine ſteel rollers very cloſe ſet, and draw " them as thin as is poſſible to retain a proper " tenacity. Poliſh them then with very fine " whiting, or rotten ſtone, till they ſhine, " and have as much brightneſs as can be " given them, and they will then be fit to " receive the colour."

But where the yellow or rather orange colour of the ground would be injurious to the effect, as in the caſe of purples, or crimſon red, the foil ſhould be whitened, which may be done by ſilvering it in the following manner.

" Take a ſmall quantity of ſilver, and diſ- " ſolve it in *aqua fortis*, and then put bits of " copper into the ſolution, and precipitate the " ſilver; which being thus precipitated, the " fluid muſt be poured off, and freſh water ad- " ded to it, to waſh away all the remainder of " the firſt fluid; after which the ſilver muſt be " dried. An equal weight of cream of tartar " and

"and common ſalt muſt then be ground with
"it, till the whole be reduced to a very
"fine powder; and with this mixture, the
"foils, being firſt ſlightly moiſtened, muſt
"be rubbed by the finger, or a bit of linen
"rag, till they be of the degree of whiteneſs
"deſired; after which, if it appear to be
"wanted, the poliſh muſt be refreſhed."

Inſtead of rolling, the more general practice is, to beat the copper-plates, previouſly heated, betwixt two flat irons on an anvil, till they become of the thickneſs required, and then to give them an even ſurface, by a planiſhing hammer, before they are poliſhed; but the uſe of the rollers is much more expeditious and effectual where the quantity demanded can defray the expence of purchaſing them, with the other neceſſary work.

The tin foils are only uſed in the caſe of colourleſs ſtones, where quickſilver is employed; and they may be drawn out by the ſame rollers, but need not be further poliſhed, as that effect is produced by other means in this caſe.

SECTION II.

Of the colouring foils.

THERE have been two methods invented for colouring foils, the one by tinging the ſurface of the copper of the colour

lour required by means of ſmoke; the other by ſtaining or painting it with ſome pigment or other colouring ſubſtance. The firſt is limited only to colours where blue is prevalent, and, being troubleſome and uncertain in the production, is not, on the whole, ſo eligible, in any caſe, as the latter; and I ſhall therefore omit giving any directions for the practice of it, as all colours deſired may be given to the foils by the other method; that is, by laying a pigment or other colouring ſubſtance on the ſurface, by means of ſome proper vehicle that may ſerve for ſpreading it, and fixing it to the copper as a cement.

The colours uſed for painting foils may be tempered with either oil, water rendered duly viſcid by gum Arabic, or ſize, or varniſh; and as there is no preference of one method to the other, but in particular caſes, it is beſt to purſue all of them, according to the occaſions that may be beſt ſerved. Where deep colours are wanted, oil is moſt proper, becauſe ſome pigments become wholly tranſparent in it, as lake or Pruſſian blue; but yellow and green may be better laid on in varniſh, as the yellow may be had in perfection from a tinge wholly diſſolved in ſpirit of wine, in the ſame manner as in the caſe of laquers; and the moſt beautiful green is to be produced by diſtilled verdigriſe, which is apt to loſe its colour, and turn black with oil. In common caſes, however, any of the colours may be, with leaſt trouble, laid on with iſinglaſs ſize, in the ſame manner as the

glazing

glazing colours uſed in miniature painting, for which ample directions may be found in the firſt volume of this work, from p. 178 to p. 186. The manner of uſing the colours in varniſh will be likewiſe found in p. 190, and the following. The beſt method therefore of adapting foils to all the ſeveral purpoſes is as follows.

For red, where the ruby is to be imitated, carmine, with a little lake uſed in iſinglaſs ſize, or ſhell-lac varniſh, is to be employed, if the glaſs or paſte be of a full crimſon verging towards the purple; but if the glaſs incline to the ſcarlet, or orange, very bright lake (that is not purple) may be uſed alone in oil.—For the garnet red, dragon's blood, diſſolved in ſeed-lac varniſh, may be uſed;—and for the vinegar-garnet, the orange lake, (for the making which directions are given, p. 119 of the firſt volume of this work) tempered with ſhell-lac varniſh, will be found excellent.

For the amethyſt, lake, with a little Pruſſian blue, uſed with oil, and very thinly ſpread on the foil, will completely anſwer the end.

For blue, where a deep colour, or the effect of the ſapphire is wanted, Pruſſian blue, that is not too deep, ſhould be uſed in oil, and it ſhould be ſpread more or leſs thinly on the foil, according to the lightneſs or deepneſs of which the colour is required to be.—For the eagle-marine, common verdigriſe, with a little

Pruſſian blue, tempered in ſhell-lac varniſh, may be uſed.

For yellow, where a full colour is deſired, the foil may be coloured with yellow laquer, laid on as for other purpoſes; for which full inſtructions are given in the firſt volume of this work, p. 506; and for the ſlighter colour of topazes, the burniſh and foil itſelf will be ſufficiently ſtrong without any addition.

For green, where a deep hue is required, the chryſtals of verdigriſe, tempered in ſhell-lac varniſh, ſhould be uſed; but where the emerald is to be imitated, a little yellow laquer ſhould be added, to bring the colour to a truer green, and leſs verging to the blue.

The ſtones of more diluted colour, ſuch as the amethyſt, topaz, vinegar-garnet, and eagle-marine, may be very cheaply imitated by tranſparent white glaſs or paſte, even without foils. This is to be done by tempering the colours above enumerated with turpentine and maſtic, treated in the manner above directed, p. 329, for doublets, and painting the ſocket in which the counterfeit ſtone is to be ſet with the mixture, as well that as the ſocket and ſtone itſelf being previouſly heated. In this caſe, however, the ſtone ſhould be immedistely ſet, and the ſocket cloſed upon it before the mixture cool and grow hard.

The orange lake above-mentioned was invented for this purpoſe, in which it has a beautiful effect, and was uſed with great ſucceſs by a conſiderable manufacturer. The colour

lour it produces is that of the vinegar-garnet, which it affords with great brightneſs.

The colours above directed to be uſed in oil ſhould be extremely well ground in oil of turpentine, and tempered with old nut or poppy oil; or, if time can be given for their drying, with ſtrong fat oil, prepared as in p. 426 of the firſt volume of this work, diluted with ſpirit of turpentine, which will gain a fine poliſh of itſelf.

The colours uſed in varniſh ſhould be likewiſe thoroughly well ground and mixt; and, in the caſe of the dragon's blood in the ſeed-lac varniſh and the laquer, the foils ſhould be warmed before they are laid on.

All the mixtures ſhould be laid on the foils with a broad ſoft bruſh, which muſt be paſſed from one end to the other, and no part ſhould be croſſed, or twice gone over, or, at leaſt not till the firſt coat be dry; when, if the colour do not lie ſtrong enough, a ſecond coat, or even a third may be given.

SECTION III.

Of foils for chryſtals, pebbles, or paſte, to give the luſtre and play of diamonds.

THE manner of preparing foils, ſo as to give colourleſs ſtones the greateſt degree of play and luſtre, is by raiſing ſo high a poliſh or ſmoothneſs on the ſurface as to give them the effect of a mirror, which can only be done, in a perfect manner, by the uſe of quickſilver applied in the ſame general way as in the caſe of looking-glaſs. The method by which it may be beſt performed is as follows.

"Take leaves of tin, prepared in the ſame "manner as for ſilvering looking-glaſſes, and "cut them into ſmall pieces of ſuch ſize as to "cover the ſurface of the ſocket of the ſtones "that are to be ſet. Lay three of theſe then "one upon another, and, having moiſtened "the inſide of the ſocket with thin gum water, "and ſuffered it to become again ſo dry that "only a ſlight ſtickineſs remains, put the three "pieces of leaves, lying on each other, into "it, and adapt them to the ſurface in as even "a manner as poſſible. When this is done, "heat the ſocket, and fill it with warm quick-"ſilver, which muſt be ſuffered to continue "in it three or four minutes, and then gently

"poured

"poured out. The ſtone muſt then be thruſt "into the ſocket, and cloſed with it, care "having been taken to give ſuch room for it "that it may enter without ſtripping off the "tin and quickſilver from any part of the ſur-"face. The work ſhould be well cloſed round "the ſtone, to prevent the tin and quickſilver "contained in the ſocket from being ſhaken "out by any violence."

The luſtre of ſtones, ſet in this manner, will continue longer than when they are ſet in the common way, as the cavity round them being filled in this manner there will be no paſſage found for moiſture, which is ſo injurious to the wear of ſtones treated in any other way.

This kind of foil gives ſome luſtre to glaſs, or other tranſparent matter which has little of itſelf; but to ſtones, or paſtes, that have ſome ſhare of play, it gives a moſt beautiful brilliance. It has been but little practiſed hitherto, I ſuppoſe from an ignorance of the manner of doing it; for, indeed, I never heard of more than one perſon, who is now gone from this country, who performed it to perfection; but he gave the ſtones a ſurprizing luſtre that made them not diſtinguiſhable from diamonds even by day-light. There is nevertheleſs at preſent one diſadvantage attending this method as it is now practiſed, which is, that it can be only performed in the caſe of ſtones with a flat bottom. In conſequence of which, the roſe or table diamonds only can

be imitated by it. But though the manner of doing it has not been hitherto diſcovered, yet it is certainly not impoſſible to contrive ſome way of ſetting ſtones of the cut of brilliants in this manner, in which caſe, if any of the chryſtal ſpecies, ſuch as thoſe called Briſtol ſtones, Kerry ſtones, &c. were to be uſed, their far greater hardneſs, as well as much higher luſtre, when treated in this way, would render them far ſuperior to paſtes.

PART IV.

Of the nature, composition, glazing, painting, and gilding of porcelain, or China-ware, and the conversion of glass into porcelain.

CHAP. I.

Of the general nature and management of porcelain and China-ware.

PORCELAIN, or China-ware, is formed of an artificial substance of a middle nature betwixt earthen-ware and glass. It resists fusion in the fire, when perfect, equally with the first, and bears, in like manner, a sudden change with regard to heat and cold; but, at the same time, has, to a certain degree, the transparency, and intirely the close and even texture of the latter. The principle on which the substance of China is formed is as follows.

There are some kinds of earths, which being exposed to a strong heat, will, after some time, fuse or melt, and acquire the nature of glass, while there are others that on the contrary resist intirely the action of heat,

and remain unaltered by it, at leaſt with reſpect to that degree which can be applied by means of furnaces, or ſuch artificial fires. The firſt of theſe kinds are called *vitreſcent* earths, the others *apyrous*. Now theſe two kinds being mixt together in due proportion, they ſo operate on each other that a matter, endued with the properties above enumerated, is conſequentially produced; for the vitreſcent earth, though it is prevented by the other from liquefying ſo as to become fluid, yet melts to ſuch a degree as to make the parts of the whole cohere and gain a ſemi-tranſparency; but the other affords a body, which, not having any propenſity to melt, hinders a greater liquefaction of the whole by abſorbing the fluid formed by the other, and gives conſequently a proper rigidity or ſtiffneſs to the whole maſs when hot, and, at the ſame time, prevents its gaining, when become cold, that vitreous grain or texture which would render it more tranſparent, as likewiſe brittle, and apt to crack or fly on any ſudden change with regard to heat or cold.

The original kind of this ware, manufactured in China and Japan, was accordingly formed by a compoſition of two earths; the one vitreſcible, which is called by the Chineſe *Petunſe*; the other apyrous, or reſiſting the action of heat, ſo as not to ſuffer itſelf to be fuſed or melted by the heat of a furnace, at leaſt without the addition of ſome very powerful flux, and is called *Kaolin*.

The

The more perfect imitations of the China-ware in Europe have been, in like manner, made by the commixture of two kinds of earth. But others, where the true compoſition has not been underſtood, or the proper materials were not to be procured, have been formed of matter prepared by mixing with the earths ſome vitreous or fluxing ſubſtances. In conſequence of this, the proportion of ſuch fluxing ſubſtances not being duly adapted to the reſiſtance of the earth, the wares for the moſt part, (though ſome of them have been very white, and of a good conſiſtence while in the clayey ſtate for working, and capable of ſuſtaining the heat of the furnace) have yet not been able to bear hot water, when ſuddenly poured upon them, while they are cold, without cracking or ſuffering a ſeparation of their parts.

The qualities of China-ware, when perfectly good, are to be very white and tenacious, ſo as not only to bear violence without breaking, and ſtrike fire with the ſteel as flint, but, as is ſaid before, to ſuffer boiling water to be poured on it, while it is itſelf in a cold ſtate, without being broken or cracked;—to have a ſemi-tranſparent appearance;—to break without ſhewing any grain in the divided parts, but ſeeming to have in them the even texture of glaſs;—to ſhine on the exterior ſurface, as if a bright poliſh had been given to it;—to be completely fit, while the compoſition is in the ſtate of a moiſt paſte, before it be dried or baked, to be modelled or caſt with the greateſt nicety

nicety and minuteneſs, retaining the figure, though wrought into the moſt thin and ſlender parts;—to dry afterwards, without warping;—and to undergo at laſt the baking or burning, without any ſeparation of the parts, or flawing. If the compoſition, or the ware formed of it, be deficient in any of theſe points, they are ſo far faulty; and by examining any pieces of China with regard to thoſe particulars, which relate to the finiſhed ware, the comparative or abſolute goodneſs may be eaſily diſtinguiſhed.

The baking or burning China-ware is performed much in the ſame manner as is practiſed by the potters for earthen-ware; except that it is done with more care, and that ſome expedients are uſed for defending the pieces from the injury of the ſmoke or duſt of the furnace, which would deprave the colour, or infect the ſurface with ſpecks.

The glazing the ware of this kind is a very important part of the manufacture of it, and has been generally found the moſt difficult to be performed. It is done by ſpreading ſome ſoft glaſs powdered, or ſome fluxing compoſition, (either mixt with part of the matter, of which the ware itſelf is formed, or in ſome caſes without) on the ſurface of the pieces, and melting it there, ſo as when cold to make an intire covering with the ſmoothneſs and ſhining appearance of glaſs. As the compoſition of the glazing has been generally kept a ſecret by thoſe who have the direction, almoſt every

every different manufactury have employed one peculiar to themſelves, and few have ſucceeded in forming ſuch as will well anſwer the end. This may be ſeen by examining any piece of the ware, even by the naked eye; but more diſtinctly with the aſſiſtance of a glaſs that magnifies largely; through which the ſurface will appear covered with, as it were, a net-work of an infinite number of cracks, (ſome of them frequently not ſmall) that not only impair the poliſh, but give moreover a caſt of greyneſs to the colour.

The painting and gilding China-ware is much the ſame as in the caſe of enamel, except in ſome particulars; as not only the ſame compoſitions for colours ſerve equally well for both, but the manner of burning or fuſing them is alſo alike, allowing for the difference of the figure of the pieces, and the number of them generally required to be burnt together. On this part of the manufacture, the value of the ware in general moſtly depends, though it is indeed, properly conſidered, not a part of the art of making China-ware, but an auxiliary art employed only for the giving additional ornaments to it, being in fact only enamel painting applied to this purpoſe.

CHAP. II.

Of the compoſition for China-ware.

THE compoſition of the Eaſtern or proper China-ware, according to accounts that have great marks of authenticity, is from two earths; one of which is, as was before mentioned, vitreſcent, and is called *Petunſe*; the other a refractory or apyrous earth, and called *Kaolin*.

Whether the earth called Petunſe is formed of the ſpar of lead, (as it is improperly called) uſed in the Dreſden manufacture below ſpoken of, or whether of flints, or ſome ſpecies of ſand, (for experience has ſhewn they will all anſwer the end, when they have no tinging matter in them, and will calcine to whiteneſs) is not evident from any information hitherto brought to this part of the world. But the deſcription given of it is, that it is a very hard whitiſh ſtone, or of a grey inclining to the green.

The Kaolin is clearly what we call the Mica, which is a ſoft, laminated, ſhining earth, breaking into fine flakes with the leaſt compreſſion, like the *alumen plumoſum*, and glittering like ſpangles, when rubbed on the hand, or any other ſmooth ſurface. This is of different colours, ſome being of the pureſt whiteneſs, and other parcels of it yellowiſh and reddiſh,

reddiſh, and very frequently black. It is found in large beds, which appear, as it were, artificially arched over with ſtone, and is either not ſo frequently to be found as many other of the like kinds of earths, or has been unobſerved by the miners when they have met with it, perhaps from their not knowing it to be of any uſe. It was diſcovered in ſome mountains on the back of Carolina in great abundance, whither the proprietors of a work near London ſent an agent to procure it for them; but he neglecting it for other purſuits, I believe no quantity has hitherto been brought frome thence. I am moreover certain there would be no occaſion to fetch it from ſo great a diſtance, if they who have occaſion for it would make diligent enquiry after it in our own country, for I have ſeen ſome that has been found in the Derbyſhire mines.

The preparation of the Petunſe is by pounding the ſtone till it be reduced to a very fine powder, and then waſhing it over, to bring it to the moſt impalpable ſtate, which is thus performed. After the ſtone is rendered as fine as it can by pounding or grinding, the powder muſt be put into a large tub full of water, and, being ſtirred about, the upper part of the water muſt be laded out into another tub, by which means the fineſt particles of the powder will be carried into it. The water in the ſecond tub muſt be then ſuffered to ſtand at reſt ill the powder be ſubſided, and as much as can be laded off clear muſt be put back into the

the firſt tub, and there being again ſtirred about, and loaded with a freſh quantity of the moſt ſubtle part of the powder, muſt be laded again into the ſecond tub as before, and this muſt be repeated till none be left in the firſt tub but the groſſer part of the ſtone; which, not being of a due fineneſs, muſt be again pounded, and treated as at firſt. The fine powder, obtained in the ſecond tub, muſt be then freed from the water, by lading off the clear part, and ſuffering what remains to exhale, till the matter become of the conſiſtence of ſoft clay, when it will be fit to be commixt with the Kaolin for uſe.

The Kaolin is prepared in the ſame manner by waſhing over, but I have ſeen ſpecimens of ſuch as was ſo fine that there was no occaſion for this, or any other purification.

From theſe two mixt together, the clay or paſte is formed; but it is ſaid, that the proportion of the reſpective quantities is made to vary accordingly to the intended goodneſs of the ware, the beſt being made from equal quantities, and the worſt from two of the Kaolin to one of the Petunſe. I do not ſee, nevertheleſs, any advantage ariſing from this, as at the ſame time the ware is rendered worſe, no ſaving is made, but the contrary effect produced; for I take it for granted, that the Kaolin, or Mica, is every where more ſcarce than the Petunſe, or vitreſcent earth; and moreover much more fire, both with reſpect to degree and continuance, is neceſſary for the

compo-

composition, where the proportion of vitrescent earth is so small, than where it is in an equal quantity with the apyrous. I am apt therefore to believe there has been a mistake or omission in this part of the account, and that, though the proportion of one-third of the Kaolin to two-thirds of the Petunse may be right in forming the composition for the worse kind of China, yet the other two-thirds are supplied by calcined flints, or some other earth more vitrescent than the Petunse, which might be procured with much less labour and expence, and at the same time would require less force and duration of fire, than if the full proportion of Petunse were used.

The Saxon composition of the matter of which the China-ware is formed, is greatly similar to that of the Eastern. In the place of the Petunse, a stone is used, which is improperly called in the German language *bley spath* or spar of lead. It is not a spar, but of a very contrary nature, as the spars are calcarious, that is, will on calcining become lime, while, on the other hand, this is of a vitrescent nature, though it is said no fire will fuse it without some mixture. This spar is of a very hard texture, and of a light flesh colour, or pale whitish red. It is prepared by pounding and washing over, which may be done by the means above directed, and is then ready for compounding with the Mica. The Mica is employed in the Saxon composition for the other ingredient, and is likewise prepared by grinding

grinding and washing over, when it is not in a perfect and pure state; but when it is intirely free from all foulness, it is only tempered with water till the texture be thoroughly broken, and it be of the consistence of soft clay.

The two kinds of earth being thus prepared, and in the state of a soft paste, they are to be incorporated and intimately commixt together in one mass, which is done by rolling and stirring them well after they are put into the same vessel, and then kneading them, by treading with the feet, till a thorough union be procured. When the compound mass is thus formed, it is made up into cakes, or square pieces, and put by layers into cases of wood or stone, which must be placed in a moist situation, and left for two or three months; during which time a kind of putrid ferment happens in the mixture, by which the parts of the different matter combine and form a substance with new qualities, not found in either of the kinds while separate. This change shews itself by a fetid smell, and a greenish or blueish colour, which comes upon the whole mass, and a tenacity or cohesion like that of clay, or the argillaceous earths moistened, which was wanting in the matter at its first mixture. If the time of keeping the paste in this condition be prolonged for the space of a year or more, it will yet improve the qualities of it, but great care must be taken to avoid its becoming dry; to prevent which, if there may be occasion, it

is

is very proper to water it. When, however, the above qualities are found in the matter, it may be deemed fit for uſe, and veſſels or other pieces may be wrought of it, without any other preparation, unleſs in the caſe below excepted.

There are many other compoſitions which are, or may be uſed for imitation of the Eaſtern China-ware; but it does not appear practicable, from any other inſtance already known, to produce a matter endued with all the requiſite qualities from the commixture of earths only without the addition of ſome fluxing or vitreous body, which may aſſiſt in giving them that tenacity and tranſparency which is neceſſary. The following compoſition however will produce wares which will have the properties of the true China, if they be rightly managed in the manufacture.

"Take of the beſt white ſand, or calcined "flints, finely powdered, twenty pounds, add "to it of very white pearl-aſhes five pounds, "of bones, calcined to perfect whiteneſs, two "pounds. Temper the whole with gum "water, formed by diſſolving the gums Arabic "or Senegal in water."

This requires a conſiderable force and continuance of heat to bring it to perfection, but will be very white and good when it is properly treated. Where Mica can be obtained, it is preferable to the calcined bones, and as it will form a paſte of kindly texture for working, a weaker gum water will ſerve, the ne-

ceſſity of uſing which at all in this kind of compoſitions is occaſioned only by the want of proper coheſion and tenacity in the paſte which ſuch mixtures make.

"Take of the beſt white ſand, or calcined "flints, finely powdered, twenty pounds, of "very white tobacco-pipe-clay, or the Cor-"niſh ſoap rock clay, waſhed over, five pounds, "and of the whiteſt pearl-aſhes four pounds. "Temper them with a weak gum water."

"Take of the whiteſt ſand, or calcined "flints, finely powdered, twenty pounds, of "flint, or any other colourleſs glaſs, powdered "alſo, ten pounds, and of Mica, or calcined "bones, two pounds. Temper them with "gum water ſufficiently ſtrong to give them "a due coheſion."

There have been ſeveral ſimilar compoſitions uſed for the imitation of China-ware in the works ſet on foot in different parts of Europe, and, among the reſt, I have ſeen at one of thoſe carried on near London, eleven mills at work, grinding pieces of the Eaſtern China, in order, by the addition of ſome fluxing or vitreous ſubſtance which might reſtore the tenacity, to work it over again in the place of new matter. The ware commonly produced at this manufactory had the characters correſpondent to ſuch a mixture, for it was grey, full of flaws and bubbles, and, from want of due tenacity in the paſte, wrought in a very heavy clumſy manner, eſpecially with regard to thoſe parts that are to ſupport the pieces in

drying. A very oppoſite kind is produced in another manufactory in the neighbourhood of London, for it has great whiteneſs, and a texture that admits of its being modelled or caſt in the moſt delicate manner; but it is formed of a compoſition ſo vitreſcent as to have almoſt the texture of glaſs, and conſequently to break or crack if boiling water be ſuddenly poured upon it, which quality renders it unfit for any uſes but the making ornamental pieces. A later manufactory at Worceſter has produced, even at very cheap prices, pieces that not only work very light, but which have great tenacity, and bear hot water without more hazard than the true China-ware. It may be hoped therefore that though the works at Dreſden and St. Vincennes are eſteemed the only manufactories in Europe, advanced hitherto to any degree of perfection, yet as there are no particular advantages in the ſituation of either of them that give them any claim to the monopolizing this art, we may ſee ourſelves in time as much maſters of this as of all the other manufactures duly cultivated and encouraged with us.

SECTION I.

Of the manner of formation of veſſels, figures, flowers, or other pieces of China-ware.

THE various kinds of pieces of China-ware are formed by three methods, turning, caſting, and modelling; the particular manner of doing which, being the ſame in this caſe as in others, there will be little occaſion to be explicit with regard to it.

Larger veſſels are generally turned in the ſame manner as is practiſed by the potters for ſtone or earthen-ware; but where they are intended to be of very nice and accurate figure, after they have the general form given to them, they are finiſhed by putting them into proper moulds.

Figures, as alſo pieces, or ornaments of pieces, of the nature of baſs-relief, are commonly caſt in moulds, which is done in the ſame way as plaiſter of Paris is treated; for which directions will be found in the firſt volume of this work, p. 404; but ſome detached parts of ornaments, where no great preciſion of form is required, may be beſt modelled or worked by the hand.

Flowers, and other ſuch looſe deſigns, where latitude may be given to the fancy, are alſo moſt commodiouſly modelled or wrought

wrought with the hand, with the help of a ſmall ſtick flattened at the point, a pair of pliers, and a wet ſpunge.

Where the parts of the pieces are very ſlender and thin, as particularly in the caſe of flowers, if the paſte be not of itſelf of a very tenacious conſiſtence, it ſhould be always brought to a proper ſtate of coheſion by tempering it with gum water; for the want of knowing which expedient, I have ſeen very coarſe work done with great labour, and ſubject to frequent miſcarriages, where the whole difficulty might have been eaſily ſurmounted by this means.

SECTION II.

Of the firſt baking or hardening the China-ware.

THE pieces being formed according to the manner above directed, muſt be gradually dried till they are capable of bearing heat without cracking; and they muſt be then baked for the firſt time, in order to give them a due hardneſs to bear the glazing. This baking is performed in the following manner; but before we proceed to the further particulars, it is proper to deſcribe the apparatus neceſſary for it.

The furnace for the baking the China-ware may be conſtructed in the ſame manner as the potters kilns are uſually built, and Windſor bricks, with mortar of Windſor loom, or Sturbridge clay, ſhould be employed in its fabrication, or, where they are not to be procured, ſuch bricks and clay as moſt reſemble them in their qualities, that is, in their reſiſtance to vitrifying or calcining. The magnitude of this furnace muſt be according to the quantity of ware that is to be baked in it; but it ſhould not be too ſmall, becauſe the body of fire may otherwiſe not be ſufficient to produce the effect.

The caſſettes or coffins in which the pieces are put, when placed in the furnace to be burnt, are the next material utenſils. They ſhould be of Sturbridge, or other good potter's clay, with a third of ſand, and are generally made of a round form, with a flat bottom; the rim forming the ſides being adapted to the height of the pieces they are intended to contain. They ſhould be all of the ſame magnitude, as to diameter, that one may ſtand on the other when they are ſet into the furnace, in order to their being piled one above another as high as the furnace will admit, and a cover muſt be made for cloſing the uppermoſt. Theſe caſſettes may be beſt made by turning, or, on occaſion, they may be formed in a mould.

The furnace and caſſettes being prepared the pieces of ware to be baked muſt be diſ-

poſed

poſed in the caſſettes according to the moſt advantage as to room, and then as many caſſettes muſt be ſet one upon the other in the furnace as it will commodiouſly contain, leaving ſpace for the fire to have free paſſage betwixt the piles, and taking care to put the cover over the uppermoſt caſſettes in each pile. The mouth of the furnace muſt then be cloſed, and the fire muſt be kindled, which ſhould be of wood, and augmented at firſt by ſlow degrees; after which it ſhould be raiſed ſo as to heat the caſſettes red hot in every part of the furnace, and continued in this ſtate for twelve or fourteen hours. It ſhould then be ſuffered to extinguiſh, and the furnace left to cool gradually, and, when little or no heat remains, the mouth may be opened, and the pieces taken out of the caſſettes, and they will be in a condition to receive the glazing, or to be painted with ſuch of the colours as are uſed under the glazing.

SECTION III.

Of the compoſition for, and manner of glazing, China-ware.

THE glazing of the China-ware, as was obſerved before, is one of the moſt important and moſt difficult operations in the whole

whole art of the manufacture, and is indeed the moſt imperfectly practiſed of any, with reſpect to that of the original or Eaſtern China. The method uſed by the Chineſe is however ſaid, on very good authority, to be as follows.

They take the fineſt pieces of the Petunſe, and treat them, as is above-mentioned, by pounding and waſhing over; but extract, by repeated waſhings over, the very fineſt part of the powder, which, keeping ſo moiſt with the water that the mixture forms a liquid maſs, they call the oil of Petunſe; with this oil they mix an equal weight of borax; they then quench a quantity of quick-lime, and form layers of that and dried furze, which they ſet on fire when they have raiſed a large heap. After the firſt heap is burnt to aſhes, they collect them and the lime, and form layers of them again with a freſh quantity of the furze, which they burn as before, and they repeat this five or ſix times. They then put the aſhes and lime into a veſſel with water, adding ſome borax, in the proportion of one pound to a hundred weight of the aſhes, and they waſh over the finer part of this mixture, and pour off at laſt all the fluid from the dregs, which they keep together with the ſolid part waſhed over. They mix this compoſition of lime, aſhes, and ſalts, with the mixture above-mentioned of an equal quantity of the oil of Petunſe and borax, and this compound forms the matter for glazing the ware.

Inſtead

Inſtead of the Petunſe, the ſpar of lead uſed in the Saxon manufacture may be employed for forming a ſimilar glazing, being treated in the ſame manner; and it is ſaid the glazing of the Dreſden China is actually made in the ſame way. I queſtion, however, that fact, and believe the real compoſition is a ſecret which has not hitherto tranſpired. But, if I cannot impart the method uſed there with ſo much authenticity as I could wiſh, I will, however, communicate one uſed in another conſiderable manufactory, which excels the Dreſden in this particular.

"Take of the fineſt white ſand, or calcined flints, twenty pounds, of red lead eighteen pounds, of pearl-aſhes ten pounds, and of common ſalt, decripitated, four pounds. Having levigated the ſand or calcined flints and red lead well together, and afterwards mixt them thoroughly with the pearl-aſhes and common ſalt, fuſe the compound in the manner above directed for the treatment of glaſs, till it be perfectly vitrified. Then, having ſeparated the fragments of the pot carefully from it, reduce it in a flat, agate, or porphyry mortar to an impalpable powder, and then temper it with water to the proper conſiſtence for painting."

When this glazing is to be uſed for any emboſſed, or other fine work, it ſhould be mixed with a third of its weight of the ſpar of lead, or other vitreſcent earth, uſed in the place

place of the Petunſe, in the compoſition of the paſte of which the ware is made, taking care that ſuch earth be formed of the beſt pieces of the ſpar, or other ſubſtance uſed, and that it be rendered of an extremely great fineneſs, by waſhing over. The deſign of this addition is to weaken the fluxing powder of the glazing; which, if uſed alone, would run the corners and edges of the ſmaller parts, and impair the ſharpneſs and ſpirit of the work. It is neceſſary, likewiſe, to purſue the ſame method in the caſe of pieces that are to be painted with deſigns of a more delicate kind; for the glazing, melting otherwiſe again in the burning in the colours, would become too fluid, and ſpread them ſo as to take away the effect of the fine touches.

The compoſition for glazing, of which kind ſoever it be, thus prepared and tempered to a due conſiſtence, muſt be laid on the pieces of the ware after the firſt baking, and after ſuch of them as are to be coloured under the glazing have been painted. This muſt be done with a proper bruſh, or with pencils, if there be emboſſed work or hollows, the greateſt care being taken to ſpread it evenly on every part of the ſurface, and not to fill or load the hollow parts, which are very apt to collect more than their due proportion from the bruſh. The glazing compoſition ſhould be laid on the ware of the thickneſs of two ſheets of writing paper, which, in caſe of nicer kinds of

of emboſſed work, is beſt done in two or three different coats, giving time for the one to be nearly dry before the other be laid on. When the pieces are thus covered with the matter of the glazing, they are ready for the ſecond baking or burning.

SECTION IV.

Of the ſecond baking or burning of the China-ware.

THE pieces of ware being glazed, muſt undergo a ſecond baking or burning, in order to their due vitrification and hardening; the firſt being only to give them a proper tenacity and firmneſs to bear the laying on the glazing. But this operation being performed in a furnace of a different ſtructure from the other, and which it is therefore proper to deſcribe in this place, I ſhall give directions for the conſtruction of it, before I proceed to ſpeak further of its uſe.

This furnace is compoſed of four ſeparate cavities, one over the other; the firſt of which ſerves as an aſh-hole, and for conveying the air to the fuel through the bars; the ſecond for a repoſitory for the fuel; the third is an oven or kiln for receiving the ware that is to be burnt; and the laſt as a vent for the ſmoke, in order to preſerve a communication with the chimney,

chimney, and at the ſame time ſpread the flame and heat equally on all the piles of caſſettes placed in the cavity under it. In order to erect ſuch a furnace, the following method muſt be purſued; but the dimenſions of the whole furnace may be varied, where there is occaſion, adhering nevertheleſs to the ſame proportion.

The ground plan muſt be firſt marked out, of ſuch figure and extent that it may allow of an oval cavity, of which the larger diameter is ſix feet, and the leſſer four feet and a half, ſurrounded with a proper wall of the thickneſs of one brick and a half. The area of this incloſed ſpace being marked out, the ground muſt be dug away within the circumſcribed ſpace, till a hole of the ſame figure and dimenſions, and with a level bottom, be made of the depth of nine or ten inches below the level of the place. In the front of this hole, a furrow or trench muſt be alſo dug, of about a foot wide, and ſloping gradually from the level ground of the place to the bottom of the hole; and it ſhould alſo be lined at the bottom and ſides with bricks or tiles for keeping the earth from breaking into it. The foundation of the brick-work muſt then be laid, by raiſing, within the hole, a wall round the ground which circumſcribes it, of the thickneſs of one brick and a half, diſcontinuing the round, nevertheleſs, in the part where the furrow or trench enters. This wall may be built of common bricks, pointed with mortar

made

made of lime and ſifted aſhes, and may be carried up to the height of three or four inches above the common level of the ground of the place, and then a ſtrong frame with iron bars, for ſupporting the fuel, muſt be fixt, bearing ſufficiently on the brick-work. A door and frame muſt likewiſe be placed in a proper poſition in the front of the furnace, for putting the fuel upon the bars, after which, the brick-work may be again proceeded with, in the ſame manner as before, till it be a foot or fourteen inches above the bars. A roofing ſhould be then formed of, as it were, ſeveral arches, ſo as to give as much opening as poſſible into the cavity where the caſſettes with the ware are to be placed, and at the ſame time to furniſh a proper flooring for ſupporting them; to which end the inequality of the ſurface formed by theſe arches on their upper ſide muſt be taken away, by filling up the hollow part, till a level be obtained, and the flooring ſo formed be, as it were, a grate of brick-work. The wall of the furnace muſt then be carried up ten feet, in the ſame dimenſions and figure as at firſt; but this part requires only to be of one brick thickneſs, and muſt have an opening in front ſufficiently large to ſuffer the caſſettes to be put in and piled upon each other; as alſo another ſmaller opening for looking into the furnace, and taking out ſmall pieces, placed within reach, to ſerve as proofs for examining the progreſs of the operation, in order to judge when

when it is perfected. This principal chamber, or cavity of the furnace, muſt be terminated by a dome of the brick-work, perforated in ten or twelve places, to afford ſo many vents to the ſmoke, of which three muſt be placed in the middle, in a triangular ſituation. Theſe vents or holes muſt have regiſters or ſtoppers of baked clay fitted to them, in order that any of them may be ſtopped when the draught of the fire ſeems unequal, and one ſide of the furnace has more heat than the other. Over this arched cavity muſt be raiſed another of about four or five feet in height, which may be formed by continuing the oval-figured wall of the furnace, and ending it by another dome of brick-work. Into this cavity an opening muſt be made like the mouth of an oven, ſufficiently large to admit of the ſtoppers or regiſters of the vents or openings into it from below being taken out, and put in occaſionally, by means of a proper pair of tongs. In the middle of the dome, the chimney muſt be formed by carrying up a tube or funnel of very ſlight brick-work, of the diameter of about ſix inches, and the height of about three feet; or, inſtead of brick-work, this tube or funnel may be made of the red earthen-ware, which is at preſent frequently applied to ſuch purpoſes near London, and will be a much leſs load to the furnace than brick-work, though ever ſo ſlight. A regiſter, which may be made by a ſliding plate of iron, ſhould alſo be placed at the vent into this

this chimney, that it may be closed up, when necessary, and all draught or communication betwixt the external air and the furnace prevented. The whole of the furnace above the bars for bearing the fuel, except the uppermost dome and the chimney, should be built of Windsor bricks, and mortar formed of Windsor loom or Sturbridge clay; or, where they are not to be had, of such other kinds as will best bear the force of the heat. And it would be a great advantage likewise to point the chamber, where the fuel is contained, as likewise the arch work and flooring over it, with the fire-lute; for the composition and treatment of which, directions will be found in the first volume of this work, p. 14.

The manner of baking or burning the China-ware in this furnace, is by putting the pieces as before mentioned in cressettes, and raising piles of the cressettes in the kiln, or principal chamber of the furnace, one over another, till the furnace be as full as it can well bear to be, leaving room for the fire to pass betwixt the piles, and play round them, as also to vent itself properly through the openings of the dome at the top. Some small pieces must be likewise put in as proofs, which should be reposited in a cressette that has an opening in the side of it, which must be placed near and opposite to the opening in the chamber, before directed to be made for examining these proofs. When the whole is thus properly adjusted within the furnace, the openings into the

the principal chamber, as likewiſe that into the upper one for venting the ſmoke, muſt be cloſed, by walling up the large one, and luting a fire-ſtone adapted to the figure of them in the two ſmaller. The fire muſt then be kindled, and kept at firſt low, increaſing it only a few degrees for twenty-four hours. After this it muſt be augmented, from hour to hour, till it be raiſed to the higheſt degree that the furnace will admit of, and in that ſtate it muſt be continued for ſix hours; by which time, if the compoſition of the paſte were good, the ware will be vitrified to the proper degree, and attain all the qualities above-mentioned to be requiſite. But to be certain of this, it is proper to examine the proofs; which, if found to be ſatisfactory, the fire ſhould be ſuffered to decay; and, after ſome hours, all the openings into the furnace, and communications with the external air, ſhould be effectually cloſed and ſtopped up, to prevent the cracking, as well of the caſſettes as the ware they contain, on their becoming cold. In this condition the furnace ſhould remain till the whole be perfectly cool; for which two or three days may be allowed. The ware may be then taken out, and will be fit for painting, where it is intended to be ſo ornamented. But that there may be a greater certainty of ſucceſs, it is neceſſary, in conducting the operation, to obſerve attentively whether the flame and heat above deſcribed ſpread themſelves equally and duly in all the parts of the furnace;

furnace; and, if one ſide appear hotter than the other, from an irregular diſtribution of the draught of the furnace, one or two of the vents, placed in the triangular manner in the dome of the chamber, muſt be cloſed, that the flame may be determined to paſs in a greater proportion up the other ſide of the furnace; and, if this do not ſuffice, ſome of the other vents may be likewiſe cloſed. It ſhould be alſo obſerved to keep the fire as much as poſſible of one regular pitch, allowing nevertheleſs for the gradual augmentation; as otherwiſe, if it be alternately ſunk and raiſed, it will be impracticable to form any effectual conjecture with reſpect to the time required for completing the operation.

SECTION V.

Of the painting and gilding the China-ware.

THERE are two methods of treatment of the China-ware, with reſpect to the painting; the firſt is, to lay on the colour under the glazing; the other, over it. The firſt is the moſt expedite, becauſe it prevents the trouble and expence of a third burning; the ſecond fully anſwering the purpoſe of fluxing the colour. But the painting before the glazing be laid on is only practicable with re-

ſpect to blue, and the browniſh or foul ſcarlet red, which is ſeen along with the blue ſo frequently in the Oriental China; the other colours being too tender to bear ſo long a duration of heat and the fluxing power of the glazing, without flying or ſpreading themſelves out of their proper bounds.

The painting, therefore, thus made under the glazing, muſt be performed by laying on the colours after the firſt baking; and for blue, may be either ſmalt finely levigated, or, for darker teints, zaffer vitrified with borax in the following manner. "Take of white ſand, or "calcined flints, three parts, of calcined borax, "of pearl-aſhes, and of zaffer each one part. "Grind them well together, and then fuſe "them till the maſs be perfectly vitrified; "when levigate them a ſecond time, and they "will be fit for uſe." For the red, calcined iron, or *crocus martis*, may be uſed; for which the beſt preparation is given in the firſt volume of this work, p. 5, under the article Scarlet Oker, and the calcined iron may be mixt with an equal part of any tranſparent white glaſs reduced to an impalpable powder. Theſe colours, as the painting in this caſe is ſeldom intended to be performed with great nicety, may be tempered with water, and laid on with a pencil, as in other caſes, but as thinly as poſſible, becauſe, otherwiſe, in putting on the glazing it will be liable to be ſpread, and ſtain the white near it.

The painting, where other colours are uſed, being laid over the glazing, muſt conſequently be done after the ſecond baking; but as there is not the leaſt difference betwixt this and other enamel painting, either with reſpect to the choice or treatment of the colours, it is unneceſſary to enlarge on any particulars here, as the whole art of ſuch painting is amply explained in the firſt volume of this work, under that head; only inſtead of muffles made in the form of coffins, as there directed, which are moſt proper for flat pieces, the round muffles or caſſettes, uſed for the baking the China-ware, are the moſt expedient to be employed for this purpoſe alſo.

The gilding China-ware is moſt performed by means of the precipitate of gold made with copper, which is tempered with oil of ſpike, and laid on with a pencil, either before the glazing be put on, or along with the colours over the glazing, if it be intended to be burniſht. The more particular explanation of its preparation and uſe will be found in p. 374 of the firſt volume of this work, under the article of GILDING ENAMEL AND GLASS, as may likewiſe ſeveral other methods of gilding applicable to China-ware, under the ſame head. When the gilding on China-ware is to be burniſhed, it muſt be done, after the laſt burning, by rubbing with a burniſher of jaſper or agate, till a ſufficient poliſh be obtained.

SECTION VI.

Of the converſion of glaſs into porcelain, according to the method invented by Mr. Raumur.

THE principal on which the tranſformation of glaſs to porcelain depends, is this; that, as was obſerved before, porcelain being a glaſs imprfectly vitrified, it may be produced either by making ſuch compoſitions as will endure heat, and vitrify only to a leſs degree, without a proportionable progreſſion, beyond that point, to a more perfect ſtate; or by reducing ſuch glaſs as is perfectly vitrified back to that ſtate.

On this principal, Mr. Raumur eſtabliſhed his invention of making porcelain of glaſs; and on experiment he found it was practicable as well on the cheapeſt kinds, even that called the green glaſs, of which bottles are made, as of the finer. The manner of effecting this change is as follows.

The glaſs to be converted into porcelain ſhould be firſt wrought into veſſels, or other pieces, by the methods commonly uſed for glaſs, and when they are ſo wrought, they ſhould be put into caſſettes, ſuch as were before deſcribed, p. 358, for the burning China. Along with the pieces of glaſs muſt be put a mixture of equal parts of plaiſter of Paris and

fine

fine ſand, ſo as to fill the caſſettes, not leaving even the leaſt interſtice or void betwixt any of the pieces of glaſs. The caſſettes are then to have the covers put on them, and are to be placed one upon another, as was directed p. 359 for the China-ware, if there be more than one, and the dimenſions of the furnace admit it, and theſe caſſettes put into a proper furnace, which may be either a common potter's kiln, or any other kind where a ſimilar heat may be given, and there they muſt be continued for the uſual time given for baking pots. After thus burning a due time, and that the caſſettes are become cold, the pieces may be taken out, but will no longer appear to be glaſs, but a very beautiful kind of China, which may be afterwards painted, or otherwiſe ornamented in the ſame manner as the real.

PART V.

Of the preparation of tranſparent and coloured glazings for ſtone or earthen-ware.

N. B. *The recipes in Italic are taken from Kunckel, being, as he affirms, the true glazings uſed at Delft, and other Dutch manufactories.*

Common glazing for any kind of earthen-ware.

" TAKE of white ſand forty pounds, " of red lead twenty pounds, of pearl-" aſhes twenty pounds, and of common ſalt " twelve pounds. Powder the ſand by grind-" ing before it be mixt with the other ingre-" dients, and then grind them together; " after which calcine them for ſome time, " with a moderate heat, which muſt be leſs " than will make them melt and run to " glaſs; and when the mixture is cold, grind " it to powder again, and, when wanted, " temper it with water, and it will then be " fit for uſe."

The proportions of theſe ingredients may be varied occaſionally; for where the glazing can be fluxed conveniently with a very ſtrong fire, the quantity of ſand may be increaſed to ſixty or ſeventy pounds, which not only renders the glazing ſtronger, but makes a ſaving in the expence. The proportion of pearl-aſhes, which is the deareſt ingredient, may likewiſe be diminiſhed; or they may be wholly omitted where the ware is deſigned for very coarſe purpoſes, and not for domeſtic uſes, where the lead is very improper, being extremely apt to be corroded by acids, and to produce a very unwholeſome ſubſtance. On this account, where good manufactures are eſtabliſhed, the lead ought to be excluded from the compoſition of the glazings, and other fluxes uſed in its ſtead as in the following recipe.

Tranſparent glazing for any kind of earthen-ware prepared without lead.

" Take of white ſand forty pounds, of pearl-
" aſhes twenty-five pounds, and of common
" ſalt fifteen pounds, calcine them, and pro-
" ceed as with the above."

Where the expence can be ſuffered, this glazing may be improved by adding one or two pounds of borax, and diminiſhing the pearl-aſhes in the proportion of ſix pounds for one pound of the borax added, or ten pounds for two; in the latter caſe, two pounds of ſalt may

may be alſo kept out of the compoſition. The reaſon for this change is, that if the compoſition contain ſo large a proportion of ſalt, and the glazing be not fluxed for a long time after it is laid on the ware, it will be apt to be diſſolved by boiling water, and peel off, if it be expoſed to the action of it for any long time.

This glazing may likewiſe be rendered better by the uſe of wood-aſhes, inſtead of part of the pearl-aſhes; but it can only be well done where the aſhes can be procured to be burnt till they be white and free from all coal, or imperfectly calcined parts of the wood or vegetable matter of which they are formed. The proportion may then be as follows.

More perfect tranſparent glazing prepared with wood-aſhes.

"Take of ſand forty founds, of wood-
"aſhes, perfectly burnt, fifty pounds, of pearl-
"aſhes ten pounds, and of common ſalt
"twelve pounds."

This will make an admirable glazing, where the aſhes are pure, and a ſtrong fire can be given to flux it when laid on the ware. It will be perfectly free from the imperfection of the above, and will be very hard and gloſſy; and where the expence can be allowed, it may be made more yielding to the fire by the addition of borax, in which caſe no alteration need be made in the proportion of the other ingredients.

Preparation

Preparation of the maſticot which is uſed by the Dutch as the ground of their glazings.

" *Take of clean ſand one hundred weight,* " *of ſoda forty-four pounds, and of pearl-* " *aſhes thirty pounds. Calcine the mixture.*"

The ſoda not being employed in this country, thoſe who would uſe maſticot muſt increaſe the quantity of pearl-aſhes in an equivalent proportion, and therefore ſeventy pounds ſhould be employed inſtead of the thirty. The calcination may be performed in the ſame manner as was before directed for preparing frit, page 275.

Soda is however ſold here under the name of Barilla, and may be therefore obtained eaſily at a low price.

Preparation of maſticot for a white glazing.

" *Take of maſticot, prepared as in the pre-* " *ceding, one hundred pounds, of calx of tin* " *eighty pounds, and of common ſalt ten pounds.* " *Calcine and powder this compoſition three* " *ſeveral times.*"

The calx of tin is prepared, as has been before obſerved in the firſt volume, by thoſe who make it their buſineſs, and is ſold under the name of putty. Its goodneſs conſiſts in its whiteneſs and its purity; the firſt of which is eaſily diſtinguiſhed by comparing any parcel in queſtion with a ſpecimen of any that is known

known to be good. The adulteration of it, which is almoſt conſtantly practiſed by thoſe who prepare or ſell it, may be diſcovered with certainty by the means taught in the firſt volume of this work, p. 282; but the ſophiſtication is not, however, any other way injurious to the effect than by occaſioning an error of proportion in the ingredients of the compoſition. At preſent it is a practice, where the moſt perfect works of this kind are carried on, to add a ſmall proportion of zaffer, to break the yellow hue, and give a truer hue of white. The proportion muſt depend on the degree of yellow tinge. As blue and yellow, however, form green, the uſe of equal parts of magneſia and zaffer would be a greater improvement, as appears from the uſe of magneſia in white tranſparent glaſs for the ſame purpoſe. The quantity of the calx of tin in this recipe, which Kunckel has given as one of the white glazings uſed at Delft, would be much too great for that of the other ingredients, if he had really meant what is properly ſo called, viz. the tin calcined alone to a white ſubſtance; but he does not mean the ſimple calx of tin, but a compoſition of calcined lead and tin, as the recipe for preparing what he calls the calx of tin, ſubjoined to that above given, evidently ſhews; which recipe is as follows.

Of the preparation of the calx of tin according to Kunckel.

"*Take of lead one hundred pounds, and of*
"*tin thirty-three pounds. Calcine them in the*
"*manner practifed by the potters, and they*
"*produce what the Dutch call the fine matter*
"*for the white glazing.*"

This is at prefent an unneceffary work for the potters, as the lead is calcined in large works under the name of red lead, and fold by thofe who, carrying on great concerns, can afford it on much better terms than potters, or others who ufe it, could make it for their own confumption only.

The tin being likewife, as was above obferved, calcined by thofe who make it their particular bufinefs, and have a fuitable apparatus, is much more profitably purchafed than prepared in this ftate. The above recipe ought therefore, according to the modern practice, to ftand as follows.

More explicit recipe for the preparation of mafticot for a white glazing.

"Take of mafticot, prepared as above, one
"hundred pounds, of red lead fixty pounds,
"of calcined tin or putty twenty pounds, and
"of common falt ten pounds. Mix them,
"and calcine and powder the mixture feveral
"times."

Another

Another preparation of a white glazing.

" *Take two pounds of lead, and ſomewhat*
" *more than a pound of tin. Calcine the two*
" *metals till they be reduced to a powder, by*
" *the means uſed by the potters. Take then two*
" *parts of theſe aſhes, one part of white ſand,*
" *calcined flints, or broken white glaſs, and*
" *half a pint of common ſalt. Mix well to-*
" *gether the ſeveral ingredients, and ſet the*
" *matter to bake in a proper furnace, and*
" *urge it at length to melt.*"

The trouble of calcining the tin and lead may be ſaved here, as well as on the occaſions above-mentioned, by procuring them already reduced to a proper ſtate.

Another preparation of a white glazing.

" *Take one pound and a half of lead, and*
" *one pound of tin. Reduce them to the ſtate*
" *of a calx, and then take of the calcined*
" *matter eight parts, and of calcined flints*
" *and common ſalt each four parts. Bring*
" *the mixture by heat to a ſtate of fuſion.*"

Another preparation of a white glazing.

" *Take of lead three parts, and of tin one*
" *part. Calcine them, and then take of this*
" *matter, and of calcined flints and common*
" *ſalt, each two parts. Fuſe them by the above.*"

Another

Another preparation of a white glazing.

" *Take of lead four pounds, of tin one pound.*
" *Calcine them, and take of the matter eight*
" *parts, of calcined flints seven parts, and of*
" *common salt fourteen parts. Fuse them as*
" *the others.*"

I suspect a false print with respect to the fourteen parts of common salt, on account of the great excess of the proportion, and imagine it was intended to be only four.

Preparation of a white glazing which may be put upon vessels of copper.

" *Take of lead four pounds, of tin one pound,*
" *of flints four pounds, of common salt one*
" *pound, and of Venetian glass one pound. Melt*
" *the mixture, and it will be fit for use.*

This is according to the expression of Kunckel, but it must be understood that by the lead and tin is meant red lead and the calx of tin, and that the flints must be always calcined. This is called by Kunckel a glazing, but, by the application of it to copper, it comes within the notion of enamel, and ought to be called white enamel.

Another preparation of a white glazing.

" *Take of lead six pounds, and of tin one*
" *pound. Calcine them, and take of the mat-*

" *ter*

"*ter twelve parts, of flints fourteen parts, and of common ſalt eight parts. Fuſe them as the others.*"

Preparation of a very fine white glazing.

"*Take of lead two parts, and of tin one part. Calcine them, and take of the matter one part, of flints and common ſalt each one part. Fuſe the mixture.*"

Preparation of an enamel for earthen-ware for painting white upon a white ground.

"*Take of tin any quantity, and incloſe it in clay or loom, and put it in a crucible. Place the crucible in the fire, that the tin may calcine, and then break it. There will be found a calx very white, and when it is uſed to paint with on a white ground, the colour will come forth, and be much more white than that of the ground.*"

This recipe appears very extraordinary; for I can by no means believe that tin, thus treated, can be all calcined, as the action of the air, or the preſence of nitre, are equally neceſſary with heat to that end; nor does it ſeem probable, if the tin was calcined by this means, that it would be a calx of greater whiteneſs than when calcined by any other method. I have inſerted it nevertheleſs as given by Kunckel, who ſays immediately below, that he has tried all theſe recipes himſelf,

or

or ſeen them tried by others. If however (as I am certain it is not to be produced this way) a calx of tin of extraordinary whiteneſs be wanted for painting on a white glazed ground, the tin ſhould be calcined by means of nitre, for which directions are given p. 283 of the firſt volume of this work; and the calx formed by that operation, if rightly managed, will be extremely white and fit for the purpoſe.

Preparation of a yellow glazing.

" *Take of tin and antimony each two pounds,* " *of lead three pounds; or, according to ſome,* " *equal quantities of all the three ingredients.* " *Calcine all of them, and put them at laſt in* " *fuſion, that they may be vitrified. This glaz-* " *ing will run very ſoon, and be of a fine* " *yellow colour.*"

The calcining the tin, lead, and antimony together, as ſeems here directed, would be a very tedious operation. The calcined tin, as commonly to be procured, and red lead ſhould therefore be uſed, and the antimony ſhould be calcined alone. But it is not to be underſtood that the antimony is to be calcined for this purpoſe to whiteneſs, or the ſtate of a perfect calx, which is not eaſily practicable without nitre, and, if effected, would render the antimony incapable of producing any other colour than whiteneſs. The operation muſt therefore be performed with a ſlow fire, by roaſting,

roasting, as it were, the antimony till it lose its metallic appearance, and become a greenish powder, as is practised in the making the glass of antimony.

Another preparation of a yellow glazing.

"*Take five parts of red lead, two parts of* "*powdered brick, one part of sand, one part* "*of any of the preceding white glazings, and* "*two parts of antimony. This mixture must* "*be calcined, and then fused, and it will give* "*a fine yellow glazing.*"

Preparation of a lemon-coloured glazing.

"*Take of red lead three parts, of powdered* "*bricks that are very red three parts and a* "*half, and of antimony one part. Calcine the* "*mixture day and night, for the space of four* "*days, in the ash-hole of a glass-house furnace* "*Urge it at last to fusion, and it will produce* "*a very fine lemon-coloured glazing.*"

But it is proper to observe, that the success of the operation depends greatly on the fineness of the colour of the bricks that are powdered. Those which are of a fine red, and very brittle, are the best; but such as are grey will not at all answer the end. The same attention should be had to this matter wherever bricks are used in these kind of preparations.

Another preparation of a yellow glazing.

" *Take ſeven parts of the mixture of the " calxes of tin and lead mentioned before in the " recipe for preparing the maſticot for a white " glazing. Add one part of antimony, and " fuſe them together.*"

Another preparation of a yellow glazing.

" *Take four parts of white glaſs, one part " of antimony, three parts of red lead, and one " part of iron ſcales. Fuſe the mixture.*"

Another preparation of a yellow glazing.

" *Take ſixteen parts of flints, one part of " filings of iron, and twenty-four parts of " litharge. Fuſe the mixture.*"

Preparation of a light yellow glazing.

" *Take of red lead four parts, of antimony " three parts, of the mixture of the calxes of " lead and tin before-mentioned, in the prepa- " ration of the maſticot for a white glazing, " eight parts, and of glaſs three parts.*"

When the red lead and calx of tin are uſed, inſtead of the mixture of them calcined together, as was before adviſed, the proportion of the ingredients will be, of red lead ten parts, of antimony and glaſs each three parts, and of calcined tin two parts.

Preparation

Preparation of a gold-coloured yellow glazing.

" *Take of red lead three parts, of antimony*
" *two parts, and of ſaffron of Mars one part.*
" *Fuſe the mixture, and, having powdered the*
" *maſs, melt it again, and repeat this opera-*
" *tion to the fourth time, and a fine gold-*
" *coloured yellow will be produced.*"

Any preparation of calcined iron may be uſed in the place of the ſaffron of Mars, and the repeated fuſions and levigations ſeem not neceſſary.

Another preparation of a gold-coloured yellow glazing.

" *Take of red lead and antimony, each one*
" *ounce, and of ſcales of iron half an ounce.*
" *Fuſe the compoſition four or five times.*"

Another preparation of gold-coloured yellow.

" *Take eight parts of red lead, ſix parts of*
" *flints, one part of yellow oker, one part of*
" *antimony, and one part of white glaſs. Cal-*
" *cine and fuſe them together, and they will*
" *form a fine gold-coloured yellow.*"

Another preparation of gold-coloured yellow.

"*Take of red lead and of white flints each*
"*twelve parts, of filings of iron one part. Fuſe*
"*them twice.*"

This glazing will be tranſparent, though Kunckel has omitted to intimate it. Care muſt therefore be taken what ground it be laid upon, or it will not anſwer the end of a yellow, but combine with that of the ground; and, indeed, the body of colour is too weak to produce any other than a feint yellowiſh caſt even on a pure white ground.

Preparation of a green glazing to be laid on a white ground.

"*Take of calcined copper one part, and*
"*two parts of any of the preceding yellow*
"*glazings. Fuſe them twice; but when the*
"*compoſition is uſed it muſt not be laid on too*
"*thick, for that would render the colour too*
"*deep.*"

Another preparation of a fine green glazing.

"*Take of the Bohemian granate one part,*
"*of filings of copper one part, of red lead one*
"*part, and of Venetian glaſs one part. Fuſe*
"*the whole, and it will afford a very fine*

"*green.*

"*green. But the mixture may be uſed without*
"*being previouſly melted.*"

Preparation of a green glazing.

"*Take two parts of red lead, two parts of Venetian glaſs, one part of filings of copper. Fuſe the mixture, and it will be fit for uſe.*"

Another preparation of a fine green glazing.

"*Take of white glaſs one part, of red lead and filings of copper, each one part. Fuſe the mixture, and afterwards powder the maſs. Take of this powder two parts, and of Bohemian granate one part, and they will produce a very fine green.*"

Another preparation of a fine green glazing.

"*Take of any of the yellow glazings already given, and add to it an equal quantity of any of the blue glazings given below. Mix them thoroughly well together by grinding, and they will produce a green that will be bright and good, in proportion to the yellow and blue uſed for its compoſition.*"

This is the readieſt way of forming greens for every purpoſe, as by the choice of the kind of yellow and blue, and the variation of the proportion of one to the other, all ſhades

 and

and teints of green may be with certainty produced.

Preparation of a fine blue glazing.

" *Take one pound of red lead, two pounds of*
" *powdered flints, two pounds of common salt,*
" *one pound of tartar, calcined till it be almost*
" *white, half a pound of white glass or Venetian*
" *glass, and half a pound of zaffer. Fuse the*
" *whole mixture, and quench the melted mass*
" *in water. Then melt and quench the mat-*
" *ter over again, and repeat several times the*
" *same operation. The same proceeding must*
" *be adhered to in all the compositions where the*
" *tartar enters, otherwise they would be too*
" *much charged with salt, and the colour prove*
" *not fine. It is proper, moreover, to calcine*
" *the mixture gently, day and night, for forty-*
" *eight hours in a glass-house furnace.*"

Another preparation of a blue glazing.

" *Take one pound of tartar, a quarter of a*
" *pound of red lead, half an ounce of zaffer,*
" *and a quarter of a pound of powdered flints.*
" *Fuse the whole, and proceed in the manner*
" *taught in the preceding recipe.*"

Another preparation of a blue glazing.

" *Take two pounds of lead and tin. Calcine*
" *them, and add five pounds of common salt,*

" *five*

"*five pounds of powdered flints, and of zaffer,*
"*tartar, and Venetian glass, each one pound.*
"*Proceed as was before directed with regard*
"*to the calcination, and afterwards fuse the*
"*mixture.*"

The red lead and calcined tin may be used as well as in the former instances, where they are directed to be purposely calcined.

Another preparation of blue glazing.

"*Take of tartar one part, of common salt*
"*two parts, of flints one part, and of red lead*
"*and zaffer, each one part. Let the treatment*
"*be the same as with the preceding.*"

Preparation of another blue glazing.

"*Take of red lead one part, of sand three*
"*parts, and of zaffer, or, in default of it, blue*
"*enamel, one part.*"

Kunckel has directed the substitution of the blue enamel here for the zaffer, as if the effect would be the same, which is an egregious error; for the proportion of zaffer is sufficient, or indeed even too great to make the deepest blue that can be produced; whereas the same quantity of the blue enamel, so treated, can only afford a blue glazing six times lighter than its own colour.

Another preparation of a blue glazing.

"*Take one part of red lead, three parts of* "*ſand, one part of zaffer, or, in its ſtead, blue* "*enamel.*"

Beſides the errors mentioned in the obſervations on the preceding recipe, this contains another, which regards the proportion of ſand to the red lead; for the quantity of the red lead is not a ſufficient flux for half the quantity of ſand; and unleſs ſome proportion of ſalts be added, the ſand ſhould never be uſed in a greater proportion than an equal weight in theſe compoſitions.

Another preparation of a blue glazing.

"*Take two pounds of red lead, and of flints* "*and zaffer each a quarter of a pound. Grind* "*the ingredients, and fuſe them in the common* "*manner.*"

Another preparation of blue glazing.

"*Take four pounds of red lead, two pounds* "*of flints, and one pound of zaffer. Calcine* "*and fuſe this compoſition.*"

Another preparation of a blue glazing.

"*Take four ounces of red lead, three ounces* "*of powdered flints, one ounce of zaffer, half*

"*an*

" *an ounce of tartar, and one ounce of white*
" *glaſs. Fuſe the mixture, and proceed as with*
" *the others.*"

Preparation of a violet-blue glazing.

" *Take twelve parts of tartar, and an equal quantity of flints and zaffer. Proceed as with the above.*"

There is undoubtedly ſome error in this, ſince no vitrification can be produced by ſuch a compoſition in theſe proportions.

Another preparation of a violet-blue glazing.

" *Take four ounces of tartar, two ounces of red lead, five ounces of powdered flints, and half a dram of magneſia. Proceed as with the above.*"

Preparation of a fine red glazing.

" *Take three pounds of antimony, three pounds of red lead, and one pound of ruſt of iron. Grind the whole as fine as poſſible, and then paint with it.*"

Another ſimilar preparation of a red glazing.

" *Take two pounds of antimony, three pounds of red lead, and one pound of calcined ſaffron of Mars. Proceed as with the above.*"

Another

Another preparation of a red glazing yet finer.

" *Take pieces of white glaſs and reduce them*
" *to an impalpable powder. Take afterwards*
" *vitriol calcined to redneſs, or rather the* caput
" mortuum *which is left after the diſtillation*
" *of the oil of vitriol. Edulcorate the calcined*
" *vitriol, or* caput mortuum, *by waſhing with*
" *water to free it from the ſalts, and then mix*
" *as much of this calcined vitriol as there may*
" *be occaſion for with the powdered glaſs. By*
" *this means a very fine red will be obtained,*
" *that may be uſed for painting, after which the*
" *work muſt be burnt.*"

The ſcarlet oker, which is the ſame thing with what Kunckel here intends by the calcined vitriol, is the beſt of the kind that can be uſed for this purpoſe, and the manner of preparing it, in the moſt cheap and eaſy manner, is taught in the firſt volume of this work, page 51. But, after all, this colour will be only a foul orange red, ſuch as is commonly found in the old China-ware.

Preparation of brown purple glazing.

" *Take fifteen parts of red lead, eighteen*
" *parts of powdered flints, one part of mag-*
" *neſia, and fifteen parts of white glaſs. Grind*
" *the mixture thoroughly well, and then fuſe*
" *it.*"

Pre-

Preparation of a brown glazing.

" *Take of red lead and flints, each fourteen*
" *parts, and of magnesia two parts, and fuse*
" *them.*"

Another preparation of a brown glazing.

" *Take of red lead twelve parts, and of*
" *magnesia one part. Fuse them, and they will*
" *produce a glazing very soft or easy to be*
" *melted.*"

Preparation of a brown glazing to be laid on a white ground.

" *Take of magnesia two parts, and of red*
" *lead and white glass, each one part. Fuse the*
" *composition twice.*"

Preparation of an iron-coloured glazing.

" *Take fifteen parts of red lead, fourteen*
" *parts of sand or flints, and five parts of*
" *calcined copper. Calcine and fuse the mix-*
" *ture.*"

The copper must be only calcined to redness, and the fusion must be very shortly continued, otherwise a green, and not iron colour will be produced. Indeed I believe it is highly difficult to procure such a coloured glazing by this means.

Another

Another preparation of a glazing like the preceding.

" *Take twelve parts of red lead, ſeven parts*
" *of flints, ſeven parts of calcined copper.*
" *Proceed as with the laſt.*"

Preparation of a black glazing.

" Take eight parts of red lead, three parts
" of iron filings, three parts of calcined
" copper, and two parts of zaffer. This
" mixture, when it is fuſed, will produce a
" brown black; but if it be deſired to be of a
" truer black colour, the proportion of zaffer
" muſt be increaſed."

PART

PART VI.

The method of preparing and moulding papier mache, and whole paper, for the forming boxes, frames, feſtoons, &c. with the manner of making the light Japan-ware.

CHAP. I.

Of the preparing and moulding the papier mache.

THE papier mache is paper reduced to the conſiſtence of a pulp by boiling and beating, till it be of ſuch conſiſtence, that being caſt into a moiſt ſtate in proper moulds, it will receive the form or impreſſion of the figure of the mould; and being previouſly commixt with ſome gummous, or other adheſive body, will acquire a conſiderable tenacity and hardneſs, ſo as to retain the figure, and anſwer the end of wood turned or carved, or plaiſter caſt into the ſame form.

The paper uſed for making the papier mache may be of any kind, according to the nicety required in the work, to which it is applied.

plied. For very coarſe purpoſes, brown may be employed; and for the moſt nice, writing paper is beſt; and it is not very material whether the paper be clean or foul, or whether it be written or printed upon, or blank, except where it might be intended to be only moulded, and not coloured, or varniſhed afterwards, which is ſeldom the caſe.

The gum or adheſive body uſed for giving the due texture to the papier mache may be gum Arabic, glue, or iſinglaſs; but for common purpoſes, gum Arabic, or glue are uſed, iſinglaſs being too dear, and indeed gum Arabic has an advantage over either of the other, of not ſhrinking near ſo much in drying.

The preparation of the papier mache may be as follows. "Take any quantity of paper "and boil it in water, ſtirring it about with "a wooden ſpatula, till it become of a paſty "ſubſtance, and appear to have loſt its cohe"ſion. Pour off then the water from it, and "beat it in a mortar, or ſuch kind of machine "as will have the ſame effect, till it be a per"fectly ſoft and yielding pulp. Prepare in the "nean-time, a ſtrong gum water, by diſſolv"ing gum Arabic in water; and having preſſed "the greateſt part of the water out of the "pulp, add the gum water to it in ſuch pro"portion that they may produce together "the conſiſtence of a thick fluid. Put them "then into a proper veſſel, and boil them "ſlowly, till they form a paſte of the right "conſiſtence for caſting." The papier mache

che will then be ready prepared for working with the proper moulds; but the ſtiffneſs of the paſte may be varied with advantage, according to the nature of the work. That intended for pieces where the figure is ſimple, and has no ſharp or emboſſed work, requiring to be ſtiffer; while the emboſſed work, or other ſuch as has relieved parts, ſhould be thinner. The uſing glue or ſize inſtead of gum Arabic, makes a ſaving, and will anſwer extremely well in the caſe of boxes, or any other pieces of a ſimple or flat form, becauſe the ſhrinking may be allowed for in the figure of the moulds; but for emboſſed work, or deſigns where ſeveral parts muſt be joined together, the uſe of gum Arabic will be found more expedient, as the relative proportions will be much better preſerved.

The moulds in which the papier mache is caſt may be either of plaiſter of Paris, or wood. For emboſſed work, or deſigns of a more complex kind, plaiſter is preferable; but for boxes, cups, or ſimpler forms, the moulds may be beſt of wood; as ſuch will laſt for a long time, and not require renewing ſo often, from the unavoidable wear, or the injury of a ſlight accidental violence, as thoſe made of plaiſter. But in the choice of moulds, and ſubjects to which they are applied, regard ſhould be had to the figure, with reſpect to its roundneſs, or projecting parts; for emboſſed work or frames of any kind, where there are a variety of angles on one ſide, and a flat plainneſs on the other,

other, are moſt expediently managed in plaiſter; and where there are nice joints, as in the caſe of boxes, or where the figure muſt be preſerved on both ſides, wood is much more proper. The plaiſter moulds for caſting the papier mache muſt be made in the ſame manner as thoſe for caſting in plaiſter, for which ample directions are given in the firſt volume of this work, p. 404, and the following; and the manner of caſting, likewiſe, may be the ſame as is practiſed for the plaiſter, which is alſo explained there, p. 406. But it is peculiarly neceſſary, in caſting the papier mache, to greaſe the moulds extremely well, otherwiſe there will be a coheſion betwixt the matter caſt and the moulds, that will be deſtructive to both. Where any ſubject caſt is of conſiderable extenſion, and one ſide of it a blank reverſe, as in the caſe of baſs-reliefs, and other ornaments of that nature, it is uſual to lay ſlips of whole ſtrong paper over the papier mache, ſuch paper being firſt well moiſtened with gum water, or ſtrong ſize, which is rather better in this caſe. This not only makes a ſaving, but is really an advantage to the work, as it adds greatly to the ſtrength and tenacity, and more eſpecially preſerves it, during the time of its drying, from the injuries of a ſlighter violence. To anſwer this end more effectually, the paper itſelf applied to this purpoſe ſhould, however, be very ſtrong, and, where the nature of the ſubject admits of it, laid on ſeveral times doubled.

The

The wooden moulds, which are the most proper sort for forming boxes, cups, or flat pieces of any kind, where there is no embossed work, must be made in two parts; or more explicitly, there must be a convex part and a concave part; betwixt which a space must be allowed for the figure of the subject that is to be cast. These may best made of box, or other hard wood tu ned into the proper figure, and it is expedient to have two or three small perforations, or holes, through the substance of the wood of the concave part near the middle to let out the fluid when the papier mache is compressed, to give it the due form. The hollow betwixt the convex, and concave parts of the mould may be about a seventh or eighth part of an inch thick, in the case of snuff or dressing-boxes, or other pieces of the like magnitude, but it may be enlarged when bigger subjects come in question. The moulds when first used should be well greased, and placed before a fire, that they may imbibe as much as possible of the grease, which will render the oiling them afterwards, each time they are employed, more effectual.

When the moulds are prepared, the surface of the concave or hollow part must be spread over with the paste as evenly as possible, and, as nearly as can be judged, of the thickness of the hollow betwixt the two parts, and then the cover or solid part of the mould must be put over the paste and compressed till it be in its proper place. The cast being thus made,

 it

it muſt be ſuffered to remain in the mould till it gain a ſufficient ſtrength and tenacity of parts, by drying, to be able to maintain its form when taken out; and then, being freed from both parts of the mould, it muſt be dried, and afterwards varniſhed or painted, according to the purpoſe for which it is deſigned.

CHAP. II.

Of the manner of moulding, &c. the whole paper for the forming ſnuff-boxes, cups, &c.

THE manner of moulding the whole paper is much the ſame as that of the papier mache; but it can be only applied advantageouſly to the forming a piece where the ſurface is flat, and without emboſſed or raiſed work, and therefore moulds of wood are proper. The paper employed for this purpoſe ſhould be the ſtrongeſt brown kind; the texture ſhould be equal, and, if any lumps or groſſer inequalities are found, they ſhould be taken off the paper. Being cut into pieces of ſuch a figure and ſize as may beſt ſuit the form of the mould, it ſhould be then moiſtened with gum water till it be pliable and ſoft, but not ſo ſoaked or macerated as to render it too weak and tender to bear adapting to the form

form of the mould. The ſlips or pieces ſhould be then laid on the convex or ſolid part of the mould, which ſhould be firſt well oiled. Each ſhould then be bruſhed over after it is laid on with a paſte of a thin conſiſtence, made by boiling flower and water for a long time, and adding afterwards about two ounces of common ſize to a pound of the paſte. Other ſlips muſt be afterwards laid on the firſt in the ſame manner, for three or four layers, according to the thickneſs and ſtrength required in the work. When there is a due thickneſs of the ſlips laid on, the hollow mould ſhould be put over them, and preſſed down to its proper place, and there continued for ſome time; after which it may be taken off, but the paper muſt not be ſeparated from the convex or ſolid mould till it have a ſufficient hardneſs to ſupport itſelf in the form given to it by the mould. Snuff-boxes, and ſuch other pieces as have lids, or are to be made in two parts with joints, muſt have ſeparate moulds for the two parts, in the manner above directed for the papier mache. but cups, ſaucers, or other ſuch pieces, may be formed on ſolid or convex moulds only, the exterior ſurface being rendered even and ſmooth by dreſſing it with an ivory knife, or other inſtrument of the like kind, and a China or other cup already formed may on occaſion ſerve for the mould.

The boxes, cups, &c. formed of whole paper, in this manner, ought always to be af-

 terwards

terwards coated with a good varniſh, if they be intended either to bear any wear, or to contain any fluid; but, if they be intended only for the ornaments of chimney-pieces, or other ſuch purpoſes, they may be painted with fat oil tempered with oil of turpentine, and mixed with any pigment of the colour that is deſired to be given them.

C H A P. III.

Of the manner of preparing the matter, and moulding the light Japan-ware.

" TAKE ſaw-duſt of fir-wood, and ſift off, " by the uſe of two ſieves of different " fineneſs, all the moſt groſs parts and the " ſmalleſt. Melt then equal parts of reſin " and turpentine, with a half-part of bees-" wax, and put into the melted mixture as " much of the ſaw-duſt as can be added " without rendering the maſs of a thicker con-" ſiſtence than can bear to be poured. Stir " the ſaw-duſt and melted matter together " till they be thoroughly well mixt, and then " caſt them after in proper moulds. If it be " deſired to render the matter harder, a little " ſhell-lac or gum ſarcocol may be added in " powder to the mixture; but this ſhould not " be

"be done before the ſaw-duſt be well united "with the other ingredients, and the matter "ſhould be kept no longer on the fire after- "wards than may be neceſſary for melting "and mixing the ſhell-lac or gum ſarcocol "with the reſt. The whole of this mixture "ſhould be uſed at one time, for it cannot "be brought to a proper ſtate for caſting, by "being re-heated, without damaging it by "burning."

The cups, boxes, or other veſſels formed of this matter, ought to be caſt in double moulds, like the papier mache, which may be made of wood turned, or of lead, pewter, or other metals; but care ſhould be always taken to greaſe the moulds very carefully; or otherwiſe this matter, being very adheſive, will glue the parts together, ſo that they cannot be ſeparated without difficulty. The cups formed of this matter may be made thin, as it is very tenacious, and they will be extremely light.

This compoſition is not ſuperior to the papier mache, or the whole paper, for making ſnuff-boxes, or other ſuch pieces as are not to contain fluids; but for cups, ſaucers, and ſuch veſſels as are required to bear moiſture, it is far preferable; and, when varniſhed in a proper manner, is more elegant than China, with the advantage, from its lightneſs, of not heating ſo as to burn the lips, as veſſels of heavier matter are ſubject to do.

CHAP. IV.

Of the painting, gilding, and varniſhing the ſnuff-boxes, cups, &c. formed of the papier mache, the whole paper, or ſaw-duſt.

THE manner of painting the ſnuff-boxes, or other ſuch pieces, formed of the papier mache, the whole paper or ſaw-duſt may be the ſame as in other japanned work for which directions are given in the firſt volume of this work; but where it is deſired that they ſhould bear much rubbing and wear, the uſe of the ſhell-lac varniſh, as a vehicle for the colours, managed according to the method deſcribed in the firſt volume of this work, is much the moſt effectual. The painting in oil, or in the varniſh compounded of oil, and the ſandarac or maſtic, according to the directions in the firſt volume of this work, p. 230, is however more eaſy and expeditious, where the durableneſs of the work is not of great moment; but the colours ſhould in that caſe be tempered thin, that they may be laid on ſo as not to raiſe any inequality in the ſurface, to prevent the varniſh laid over them from taking a proper poliſh.

In the French manner of japanning the papier mache, the old method is purſued of laying

laying a ground under the colours and varniſh of whiting and ſize; but in the Birmingham manufacture of the ſame articles, this is omitted, and very advantageouſly with reſpect to the durableneſs of the pieces; for the coats of colour and varniſh are apt to crack with any violence, on account of their not having a firm and tenacious ſubſtance under them; and this occaſions their peeling, and ſuffering large flakes to ſeparate from the ground, when the leaſt impreſſion or crack has been made on the edges, or any other part. The different treatment of japanned work under either of theſe methods, with a more particular account of their nature, and the reaſon why the Engliſh and French manufactures differ in this particular, are ſo explicitly touched upon in p. 481 of the firſt volume of this work, that it is needleſs to enlarge further on them here.

The varniſh employed for the pieces formed of papier mache, whole paper, or ſaw-duſt, may be likewiſe the ſame as in any other kind of japanned work; for which directions will be found p. 494 of the firſt volume of this work. The moſt durable is the ſeed-lac varniſh, which may be either that made of the pickt grains, for which the recipe is given, p. 487 of the firſt volume of this work, the common kind, as in p. 497, or the cheaper ſort, as in p. 487, according to the occaſion. But for the pieces that are not ſubject to much rubbing or violence, the Florentine varniſh given in this volume, p. 91, may be employed,

as it is both cheaper, and ſaves the labour of poliſhing.

The gilding may be alſo performed by the ſame means as are uſed for other Japan work, which are taught in the firſt volume of this work, p. 501; but where the whole is gilt for a ground to the painting, the gold ſize ſhould be diluted copiouſly with oil of turpentine, and laid on as thin as poſſible.

When the painting, varniſhing, gilding, &c. is performed, it is proper in all caſes, where great firmneſs and hardneſs of the varniſh is required, to bake the pieces in a proper ſtove, beginning with a gentle heat, and increaſing the degree to the greateſt that can be given without changing the colour of the varniſh, or the painting, by burning them. But this is more particularly requiſite in the caſe of cups and ſaucers made of the whole paper, or ſaw-duſt, which are to bear hot water; for there baking them a conſiderable time, in a ſtrong heat, renders the varniſh proof againſt any injury that could be done to it, even by boiling water.

The true Japan black laquer (which is now frequently brought from China) has been ſometimes uſed for the varniſhing ſnuff-boxes, cups, and all ſuch pieces made of the paper or ſaw-duſt. But this laquer, being the concreted juice of the toxicodendron tree, its poiſonous qualities are almoſt conſtantly fatal to thoſe who work with it for any length of time, and ſometimes even on very ſlight inter-

meddling

meddling with it. Such a momentous inconvenience, together with the tedioufneſs of diſpatching the work, on account of its great tardineſs in drying, being extremely good reaſons againſt its uſe, it is much more adviſeable to employ the common kinds of varniſh, which, when managed judiciouſly, may be rendered nearly both as beautiful and durable, without either the danger or the difficulty attending the other.

When the true Japan varniſh is however uſed, all heat muſt be avoided; for, contrary to the nature of moſt other ſubſtances of the ſame kind, this dries beſt when moſt expoſed to moiſture, and can indeed only be brought to a proper ſtate of hardneſs by keeping it in ſome place which is either naturally damp or made ſo artificially.

APPENDIX.

CONTAINING

Several ſupplemental articles, belonging in ſome manner to heads before treated of, either in the firſt or ſecond volumes.

APPENDIX.

Of the method of preparing and colouring marbled paper.

THERE are ſeveral kinds of marbled paper, but the principal difference of them lies in the forms in which the colours are laid on the ground, ſome being diſpoſed in whirles or circumvolutions, ſome in waving jagged lengths, and others only in ſpots of a roundiſh or oval figure. The general manner of managing each kind is nevertheleſs the ſame, being the dipping the paper in a ſolution of gum tragacanth, (or, as it is commonly called, gum dragon) over which the colours, previouſly prepared with ox-gall and ſpirit of wine, are firſt ſpread.

The peculiar apparatus neceſſary for this purpoſe is a trough for containing the gum tragacanth and the colours, a comb or quill for diſpoſing them in the figure uſually choſen, and a burniſhing ſtone for poliſhing the paper. The trough may be of any kind of wood, and muſt be ſomewhat larger than the ſheets of paper

paper for marbling which it is to be employed; but the ſides of it need only riſe about two inches above the bottom, for, by making it thus ſhallow, a leſs quantity of the ſolution of the gum will ſerve to fill it. The comb may be alſo of wood, and five inches in length, but ſhould have braſs teeth, which may be about two inches long, and placed at about a quarter of an inch diſtance from each other. The burniſhing ſtone may be of jaſper or agate, but as thoſe ſtones are very dear, when of ſufficient largeneſs, marble or glaſs may be uſed, provided their ſurface be poliſhed to a great degree of ſmoothneſs.

Theſe implements being prepared, the ſolution of gum tragacanth muſt be made, by putting a ſufficient proportion of the gum, which ſhould be white and clear from all foulneſſes, into clean water, and letting it remain there a day or two, frequently breaking the lumps and ſtirring it till the whole ſhall appear diſſolved and equally mixt with the water. The conſiſtence of the ſolution ſhould be nearly that of ſtrong gum water uſed in miniature painting; and, if it appear thicker, water muſt be added, or, if thinner, more of the gum. When the ſolution is thus brought to a due ſtate, it muſt be paſſed through a linen cloth, and being then put into the trough, it will be ready to receive the colours.

The colours employed for red are carmine, lake, roſe-pink, vermilion, and red lead; but the two laſt are too hard and glaring, unleſs they

they be mixt with roſe-pink, or lake, to bring them to a ſofter caſt; and with reſpect to the carmine and lake, they are too dear for common purpoſes;—for blue, Pruſſian blue and verditer may be uſed;—for yellow, Dutch pink and yellow oker may be employed;—for green, verdigriſe, a mixture of Dutch pink and Pruſſian blue, or verditer, in different proportions;—for orange, the orange lake, as directed to be prepared page 119 of the firſt volume of this work, or a mixture of vermilion, or red lead, with Dutch pink;—for purple, roſe-pink and Pruſſian blue.

Theſe ſeveral colours ſhould be ground with ſpirit of wine till they be of a proper fineneſs, and then at the time of uſing them a little fiſh-gall, or, in default of it, the gall of a beaſt ſhould be added, by grinding them over again with it. The proper proportion of the gall muſt be found by trying them, for there muſt be juſt ſo much as will ſuffer the ſpots of colour, when ſprinkled on the ſolution of the gum tragacanth, to join together, without intermixing or running into each other.

When every thing is thus prepared, the ſolution of the gum tragacanth muſt be poured into the trough, and the colours, being in a ſeparate pot, with a pencil appropriated to each, muſt be ſprinkled on the ſurface of the ſolution, by ſhaking the pencil, charged with its proper colour over it; and this muſt be done with the ſeveral kinds of colour

lour desired till the surface be wholly covered.

Where the marbling is proposed to be in spots of a simple form, nothing more is necessary, but where the whirles or snail-shell figures are wanted, they must be made by means of a goose-quill, which must be put among the spots to turn them about till the effect be produced. The waving jagged lengths must be made by means of the comb above described, which must be passed through the colours from one end of the trough to the other, and will give them that appearance; but if they be desired to be pointed both ways, the comb must be again passed through the trough in a contrary direction; or if some of the whirles or snail-shell figures be required to be added, they may be yet made by the means before directed.

The paper should be previously prepared for receiving the colours by dipping it over-night in water, and laying the sheets on each other with a weight over them, in the same manner as was before described in p. 197, in the case of paper to be imprinted by copper-plates. The whole being thus ready, the paper must be held by two corners, and laid in the most gentle and even manner on the solution covered with the colours, and there softly pressed with the hand, that it may bear every where on the solution; after which, it must be raised and taken off with the same care, and then hung to dry cross a proper cord, subtended near at hand for that purpose, and in that state it must continue till it be perfectly dry;

it

It then remains only to give the paper a proper polifh, in order to which it is firft rubbed with a little foap, and then muft be thoroughly fmoothed by the glafs polifhers, fuch as are ufed for linen, and called the calender glaffes; after which it fhould be again rubbed by a burnifher of jafper or agate; or, in default of them, of glafs ground to the higheft polifh; for on the perfect polifh of the paper depends, in a great degree, its beauty and value.

Gold or filver powders may be ufed, where defired, along with the colours, and require only the fame treatment as them; except that they muft be firft tempered with gum water.

Method of taking off paintings in oil, from the cloth or wood on which they were originally done, and tranfferring them intire, and without damage to new pieces.

THE art of removing paintings in oil from the cloth or wood on which they are originally done, and transferring them to new grounds of either kind of fubftance, is of very great ufe. Not only pictures may be preferved, where the canvas is fo decayed and damaged that they would otherwife fall to pieces, but paintings on cielings or wainfcot, which, when taken away from the places where they

they were originally placed, would have little value, may be conveyed to cloths; and, by being thus brought to the ſtate of other pictures, became of equal worth with thoſe painted originally on canvas. The manner in which this is done is, by four ſucceſſive operations. The firſt is, the cementing the face of the picture to a new cloth, by means of ſuch a ſubſtance as will admit of being afterwards diſſolved in water, in order to its being taken off. The ſecond is, by deſtroying the texture of the old cloth, by means of a proper corroding fluid, in ſuch manner that it may be ſeparated from the painting, and the making ſuch preparation accordingly. The third is, the cementing a new cloth to the painting, in the place of the old one now taken away. The fourth is, the corroding, and ſubſequently taking away, the cloth cemented to the face of the picture, and the cleanſing away the cement, or any remains of the cloth, by water, which, diſſolving the cement, renders it capable of being rubbed off from the face of the picture. The particular method of performing theſe ſeveral operations is as follows.

Let the decayed picture be cleanſed from all greaſe that may be on its ſurface, which may be done by rubbing it very gently with crumb of ſtale bread, and then wiping it with a very fine ſoft linen cloth. It muſt then be laid with the face downwards, on a ſmooth table covered with fan paper, or the India paper, and the cloth on the reverſe muſt be well ſoaked

with

with boiling water, ſpread upon it by means of a ſpunge, till it appear perfectly ſoft and pliable. The picture is then to be turned with the face upwards, and, being ſtretched in the moſt even and flat manner on the table, muſt be pinned down to it in that ſtate, by nails driven in through the edge, at proper diſtances from each other. A quantity of glue ſhould be then melted and ſtrained through a flannel cloth, to prevent any gravel or other impurities from lurking in it, and, when it is a little ſtiffened, a part of it ſhould be ſpread on a linen cloth, of the ſize of the painting, where it ſhould be ſuffered to ſet and dry, and then another coat put over it. When this is become ſtiff alſo, the glue ſhould be again heated, and while it remains of ſuch heat as to be eaſily ſpread, it ſhould be laid over the face of the picture, and the linen cloth, on which the glue was before ſpread, immediately put over it in the moſt even manner, and nailed down to the picture and table at the edge likewiſe. The glue ſhould not be uſed boiling hot, as that would hazard ſome of the more delicate colours of the painting; and the linen cloth ſhould be fine and half worn, that it may be the ſofter, and lie the flatter on the ſurface of the picture; in order to which it is proper to heat it till the glue be ſoft and pliable before it be laid on, and to compreſs each part gently with a ball formed of a linen rag tied round with thread. The table, with the picture, cloth, &c. nailed down to it in

 this

this ſtate, ſhould be then expoſed to the heat of the ſun, in a place where it may be ſecured from rain, and there continued till the glue be perfectly dry and hard, at which time the nails ſhould be drawn, and the picture and linen cloth taken off from the table. The picture muſt now be again turned with the face downwards, and ſtretched and nailed to the table as before, and a border of wax muſt be raiſed round the edge, in the ſame manner as is directed for the copper-plates, p. 163, forming as it were a ſhallow trough with the ſurface of the picture; into which trough ſhould be poured a proper corroding fluid to eat and deſtroy the threads of the original canvas or cloth of the picture. The corroding fluid uſed for this purpoſe may be either of oil of vitriol, *aqua fortis*, or ſpirit of ſalt; but the laſt is preferable, as it will more effectually deſtroy the thread, when it is ſo weakened by the admixture of water as not to have any effect on the oil of the painting. Whichever is uſed, it is neceſſary they ſhould be properly diluted with water; to find the due proportion of which, it is expedient to make ſome previous trials, and when they are found to be of ſuch ſtrength as to deſtroy the texture of the thread without diſcolouring it, they are in the due ſtate. When the corroding fluid has done its office, a paſſage muſt be made through the border of wax at one end of it, and the fluid muſt be poured off, by inclining the table

table in the requisite manner; and the remaining part must be washed away, by putting repeated quantities of fresh water upon the cloth. The threads of the cloth must then be carefully picked out till the whole be taken away; but if any part be found to adhere, all kind of violence, even in the least degree, must be avoided in removing them; instead of which, they should be again touched, by means of a pencil, with the corrosive fluid less diluted than before, till they will readily come off from the paint. The reverse surface of the painting being thus wholly freed from the old cloth, must be then well washed with water, by means of a spunge, till the corroding fluid employed be thoroughly cleansed away; when being wiped with a soft spunge, till all the moisture that may be collected by that means be taken off, it must be left till it be perfectly dry. In the mean-time a new piece of canvas must be cut of the size of the painting which now remains cemented to the linen cloth put on the face of it; then the reverse of the painting being dry, and spread over by some hot glue, purified as before, and melted with a little brandy or spirit of wine, the new canvas must be laid on it, in the most even manner, while the glue yet remains hot, and settled to it by compression, which may be performed by thick plates of lead, or flat pieces of polished marble. Great care should however be taken in the laying them on, to prevent the edge from cutting or bruising the

paint, as alſo, during the ſetting of the glue, to take them off, and wipe them at proper intervals, to prevent their adhering to the cloth by means of the glue, which may be preſſed through it. The lead or marble, by which the compreſſure is made, being removed when the glue is ſet, the cloth muſt be kept in the ſame ſtate till the glue be perfectly dry and hard. Then the whole muſt be again turned with the other ſide upwards, and the border of wax being replaced, the linen cloth on the face of the painting muſt be deſtroyed by means of the corroding fluid, in the ſame manner as the canvas was before; but greater care muſt be taken with reſpect to the ſtrength of the corroding matter, and in the picking out the threads of the cloth, becauſe the face of the painting is defended only by the coat of glue which cemented the linen cloth to it. The painting muſt then be freed from the glue, by waſhing it with hot water, ſpread and rubbed on the ſurface by a ſpunge, which ſhould be cleanſed frequently during the operation by dipping and ſqueezing it in clean water. The painting may afterwards be varniſhed as a new picture; and, if the operation be well conducted, it will be transferred to the new cloth in a perfect ſtate.

When the painting is originally on wood, it muſt be firſt detached from the cieling or wainſcot where it was fixed, and the ſurface of it covered with a linen cloth, cemented to it by means of glue, in the manner before directed

directed for the paintings on canvas. A proper table being then provided, and overſpread with a blanket, or thinner woollen cloth, if laid ſeveral doubles, the painting muſt be laid upon it with the face downwards, and fixed ſteady, and the boards or wood on which it was done muſt be planed away, till the ſhell remain as thin as it can be made, without damaging the paint under it. The proceedings muſt afterwards be the ſame as was before practiſed in the caſe of the paintings on canvas, till that on the wood be in like manner transferred to a cloth or canvas.

The whole of the above operation muſt be managed with the greateſt care, otherwiſe the painting will receive ſome damage; and ſo much nicety is required in the corroſion, and taking off the threads of the cloth, that it can ſcarcely be performed rightly but by ſuch as have had ſome experience in the matter. It is proper, therefore, for any perſon who would practiſe it in the caſe of valuable paintings, to try it firſt with ſome old pictures of little value, till they find they have the right method of proceeding; and even then in ſome inſtances, where the coats of paint lie very thin on the cloth, it is ſcarcely practicable without miſcarriage. But, as in the caſe of pictures greatly decayed, or paintings on wood taken from buildings that do not admit of being commodiouſly replaced elſewhere, there can be no great loſs, if a failure ſhould happen; and a conſiderable advantage may accrue, if

the experiment ſucceed, for which there is a good chance, if the operation be properly conducted, and the ſubject favourable. It is very well worth while to make the trial.

The original recipe for the making Pruſſian blue, as publiſhed by Dr. Woodward.

" TAKE any quantity of blood, and " evaporate it to dryneſs, continuing " the heat till it become black, but avoiding " the burning any part of it to aſhes. Pow- " der the dry matter, and mix it thoroughly " with an equal weight of pearl-aſhes, and " calcine the mixture in an iron pot or cru- " cible, on which a cover is put. The calcina- " tion muſt be continued ſo long as the mat- " ter emits any flame, the fire being raiſed to " a conſiderable degree of heat at the end of " the operation, and the matter muſt be then " powdered, and put, while yet hot, into " twelve times its weight of water, which " muſt be again ſet on the fire to boil for " the ſpace of three quarters of an hour, or " more. The fluid muſt then be filtered off " through a thin flannel bag, from the part " remaining undiſſolved; through which re- " maining part freſh water ſhould be paſſed, " before it be taken out of the filtering bag,

" to

" to extract as much as poſſible of the ſolu-
" tion; and the water, thus paſſed through,
" ſhould be added to the quantity before fil-
" tered; after which, what is retained in the
" bag may be thrown away. In the mean-
" time a ſolution ſhould be made of allum
" and copperas calcined to whiteneſs, in the
" proportion of two pounds of the allum, and
" two ounces of the calcined vitriol, to each
" pound of the pearl-aſhes uſed with the
" blood, which ſolution muſt be made by
" boiling the allum and copperas in five times
" their weight of water, and then filtering
" them through flannel or paper, where great
" nicety is required. When the ſolution of
" the allum and copperas is thus prepared,
" it muſt be added to the lixivium filtered
" off from the calcined blood and pearl-
" aſhes, from which mixture, the precipi-
" tation of a blackiſh green matter will ſoon
" enſue. After the precipitated matter has
" ſubſided to the bottom of the veſſel, and
" the fluid appears clear over it, ſeparate it
" from the green ſediment, firſt by pouring
" off all that will run clear out of the veſſel,
" and afterwards by ſtraining off the re-
" mainder, and then put the green matter
" again into a veſſel that will contain as much
" fluid as it was before mixt with. Add ſpi-
" rit of ſalt to it afterwards, in the proportion
" of ſix ounces to every pound of the pearl-
" aſhes uſed, and the green matter will then
" ſoon appear to be converted into a beau-
" tiful

"tiful blue. Water muſt then be added to "waſh off the ſpirit of ſalt, which muſt be "renewed ſeveral times till it come off per- "fectly ſweet, and the laſt quantity muſt "then be ſtrained off, and the blue ſediment "dried in lumps of a moderate ſize. The "produce will be about three ounces for every "pound of the pearl-aſhes employed."

This recipe was omitted in the firſt part of this work for want of room, and another inſerted, where the proportions of the ingredients are more accurately adapted to each other, in order to make a ſaving in the expence. But this recipe will produce an equally fine colour, and if the produce be deſired to be made either of a lighter or darker hue, it may be done by increaſing the proportion of the pearl-aſhes to the blood to give a lighter kind, or the ſpirit of ſalt to the pearl-aſhes to give a deeper kind; but the quantity will in the latter caſe be proportionably diminiſhed.

The ſtraining or filtering the lixivium through flannel is not ſo good a method as the doing it through paper, eſpecially where the colour is wanted of a very great brightneſs and purity, and the water is beſt ſeparated from the great ſediment firſt produced, and afterwards from the blue one by the ſame means; but in theſe caſes a fine linen cloth much worn, though whole, ſhould be laid over the paper. The colour, when reduced to a proper conſiſtence, may be laid on chalk-ſtones to dry, and a moderate heat may be alſo uſed for greater

greater expedition, when required; but great care ſhould be taken not to burn the matter. The calcination may be performed in a reverberatory furnace, ſuch as is uſed by the chymiſts, or in the furnaces where metals are melted; for the crucible or pot containing the matter may either be ſurrounded by the coals, or placed over them, provided a ſufficient heat be given to it. But where larger quantities are to be calcined, they may be very cheaply and commodiouſly managed in the potters or tobacco-pipe-makers furnaces, being put into them along with the earthen-ware and pipes. And if the calcined matter in ſuch caſe cannot be conveniently powdered while hot, and put into water, the deviating from that part of the proceſs may be diſpenſed with, not being abſolutely neceſſary, if the matter be well powdered afterwards, before it be put into the water.

Of light, red, or light oker, *(which ſhould have been inſerted* p. 69 *of the firſt volume of this work.)*

THIS pigment is an oker of a light red colour, of the ſcarlet caſt, which is very uſeful in carnations, and for many other purpoſes. It may be had of the colourmen, or may be made by calcining the yellow oker till

till it acquires the teint of orange or red desired. After the calcination, it muſt be ground and waſhed over, and then dried, either by heat or without, as may be moſt expedient. But when it is had of the colourmen, it is generally already ground and prepared for uſe; though, as they are not ſo nice in common as to waſh over the colours, that operation may be added to what they have done, where the oker is deſired to be perfectly fine.

The method of foliating or ſilvering looking-glaſſes.

THE foliating looking-glaſſes is performed by fixing quickſilver on the reverſe ſurface, by means of plates of tin; which, amalgamating or combining with the quickſilver, takes away its fluidity, and renders it ſo tenacious as to be compreſſed into a very thin coat or plate, capable of adhering to the ſurface of the glaſs.

There are ſeveral manners of laying the quickſilver and tin on the glaſs; and it is by ſome practiſed, to uſe the quickſilver alone; and by others, to compound with it tin and lead; and biſmuth has likewiſe been frequently, uſed inſtead of them; but it is not neceſſary, when the operation is well conducted, to make any addition to the quickſilver. The following

following is one of the beſt methods hitherto practiſed.

" A proper number of ſheets of thin paper
" muſt be procured; which paper ſhould be
" of a ſoft ſpungy nature, like that called
" blotting paper. This paper muſt be ſpread
" on a table with a very level even ſurface,
" and fixed very firmly; or it is better to uſe
" a marble table or ſlab. But ſo much only
" of the table ſhould be covered as may form
" an area of the ſame figure with that of the
" glaſs to be ſilvered, a little enlarged. Over
" the ſurface of the paper muſt be ſprinkled
" ſome powdered chalk, which ſhould be
" well levigated, and wholly clear of any
" gravel or impurities. Leaves of tin, which
" ſhould be rolled or beaten very thin, muſt
" then be laid upon the paper ſprinkled with
" chalk, in the moſt ſmooth and even man-
" ner; and where there is occaſion, on ac-
" count of the ſize of the glaſs, to uſe more
" than one, they ſhould be joined with great
" exactneſs, (rather ſuffering nevertheleſs the
" edge of one to bear on the other, than
" leaving any deficiency) ſo that the whole
" ſurface of the paper may be perfectly cover-
" ed. Quickſilver is to be then poured upon
" theſe leaves of tin, and ſpread over every
" part of it by a hare's foot, or the feathered
" part of a quill. Some ſheets of very thin
" ſmooth paper, of which the kind called
" fan paper is beſt, muſt be then ſpread over
" the quickſilver, leaving a margin beyond
" the

" the quickſilver, and upon this paper the
" glaſs muſt be gently laid, and then, being
" preſſed down with the one hand, the ſheets
" of the thin paper muſt be gently drawn
" from under it with the other, by taking
" hold of the margin left for that purpoſe.
" The upper ſurface of the glaſs muſt then
" be covered with thick paper, and a con-
" ſiderable weight put over it, in order to
" preſs out all the quickſilver that is not
" fixed by the tin, as well as to make it
" adhere the more firmly to the glaſs. When
" no more quickſilver appears to drain off,
" the weights and paper may be removed,
" and the operation will be completed."

Some who uſe the biſmuth add half an ounce of it to an ounce of the quickſilver. They make an amalgamation of them by melting the biſmuth, and having taken it off the fire, putting in the quickſilver gradually, and ſtirring it with an iron rod, or tobacco-pipe, till the whole be thoroughly incorporated, pouring afterwards the maſs into cold water to prevent the quickſilver from ſubliming with the remaining heat. It is proper, neverthe-leſs, before this compoſition be uſed, to ſtrain it through a cloth, and what remains, and will not be preſſed through, may be added to the next quantity to be incorporated. The proportion of tin and lead, when they are uſed in the ſame manner, is generally a compound of equal parts, in the proportion, when together, of a fourth-part of the weight of the quick-

quickſilver. It has been alſo formerly practiſed to uſe a compoſition of two parts of biſmuth, and one part of tin, with the ſame quantity of lead, and ten parts of the quickſilver.

Where the glaſſes with angular ſurfaces, called diamond cut, are to be ſilvered, a border muſt be formed on the table of the figure of the glaſs, which may be done by a moveable frame. The paper, leaves, &c. muſt be brought over this border, and the ſubſequent proceeding may be the ſame as in the caſe of the plain ſurface, only taking great care that the glaſs be properly let down within the border, ſo as to bear every where both on that and the ſurface of the table.

Globes of glaſs may be ſilvered; but as no preſſure can be given, the plates of tin cannot be uſed, and the quickſilver muſt therefore be rendered of a proper conſiſtence, by amalgamating it with ſome of the other metallic ſubſtances. The moſt approved method of doing this is as follows.

" Take of quickſilver two parts, of biſmuth
" two parts, and of tin and lead each one part.
" Melt the tin and lead together, and, when
" they are fluid, add the biſmuth. When
" that is melted likewiſe, take them from
" the fire, and put the quickſilver gradually
" to them, ſtirring the mixture till the whole
" be united. After the maſs is become ſo
" cool as not to endanger its breaking the
" glaſs, pour it into the globe to be ſilvered,

" uſing

" uſing a funnel, which will carry it to the " bottom of the globe. Move the glaſs then " gently about, ſo that the amalgamated " matter may flow over every part, and adhere " to it, which will effectually ſilver the globe. " When every part is covered, pour out the " redundant quantity, and keep the glaſs ſtill " till it be perfectly cool. If, during the " operation, the mixture appear to ſet in the " globe, and be not ſufficiently liquid to flow " about and cohere with the glaſs, a gentle " heat muſt be adminiſtered, which will re- " medy this defect; and if, on the contrary, " the matter appear too fluid, and have not " ſufficient tenacity to fix itſelf to the glaſs, " it muſt be taken out, and an additional " quantity of the biſmuth, tin, and lead, " added by means of a proper heat."

As it is very advantageous for thoſe that have occaſion to ſilver conſiderable quantities of looking-glaſſes to know how to ſeparate the quickſilver from the tin, or other ingredients, I will ſubjoin the directions for doing it in a very expedite and quick manner, with the aſſiſtance of a common fire, by means of an alembic, or ſtill, that may be conſtructed in the following manner.

Let a copper or iron pan be firſt made, of about ten inches diameter, and about four or five inches depth. Over this let a cover be ſoldered on it, in which cover muſt be fixed a ſhort tube for the pouring in the quickſilver, and taking out the recrement after the operation.

tion. This tube muſt have a ſtopper capable of being ſcrewed into it, ſo as to render the joint good againſt any eſcape of the vapour of the quickſilver, when raiſed with the pan. In the upper part of the ſide of the pan muſt be ſoldered a gun barrel, of about four or five feet in length, in a ſloping direction; the hollow of which barrel muſt communicate with the cavity of the pan, ſo that the fumes of the quickſilver may paſs into it. The end of this barrel muſt be alſo bent downward, ſo that when the pan is placed in a level ſituation on the fire, this end of the tube may be immerſed in the veſſel of water, placed aptly for that purpoſe. This veſſel may be a common pail or large earthen pan, or any other ſuch, which will contain a gallon or more of water. When this apparatus is provided, the operation is to be performed in the following manner.

" Take any quantity of the matter from " which the quickſilver is to be ſeparated, " and put it into the copper or iron alembic " or pan, and ſcrew down the ſtopper in the " hole of the tube through which the matter " is put in. Place the pan then upon the burn- " ing coals in a common fire, raiſing the coals " round the ſide, and bring the veſſel of water " under the bent end of the gun barrel, ſo that " an inch or two of it may be within the water. " The quickſilver will ſoon riſe in fumes, " which, paſſing into the barrel, will be con- " denſed there, or on the ſurface of the water " at the end of it, and will flow in drops into

 " the

" the water, and be collected at the bottom
" of the veſſel. When the whole of the quick-
" ſilver firſt put in is thus brought over, which
" may be eaſily perceived by the cooling of the
" barrel, and the drops ceaſing to fall into the
" water, the ſtopper in the ſmall tube at the
" top may be taken out, and a freſh quantity
" of the matter put in; and the ſame may be
" repeated as often as there may be occaſion.

" When all the quickſilver is diſtilled over,
" the water may be poured from it out of the
" veſſel; and being put into a baſon, or other
" ſmall veſſel, it may be freed from the remain-
" ing moiſture, by means of a ſpunge. The tin,
" lead, &c. may likewiſe be taken out of the
" alembic or pan, when it is grown cold."

Varniſh proper for pales and coarſe wood-work.

" TAKE any quantity of tar, and grind
" it with as much Spaniſh brown as it
" will bear, without rendering it too thick to
" be uſed as a paint or varniſh, and then
" ſpread it on the pales, or other wood, as
" ſoon as convenient, for it quickly hardens
" by keeping."

This mixture muſt be laid on the wood to be varniſhed by a large bruſh, or houſe-painter's tool; and the work ſhould then be kept as free from duſt and inſects as poſſible till the

the varniſh be thoroughly dry. It will, if laid on ſmooth wood, have a very good gloſs, and is an excellent preſervative of it againſt moiſture; on which account, as well as its being cheaper, it is far preferable to painting, not only for pales, but for weather-boarding, and all other kinds of wood-work for groſſer purpoſes. Where the gloſſy brown colour is not liked, the work may be made of a greyiſh brown, by mixing a ſmall proportion of white lead, or whiting and ivory black, with the Spaniſh brown.

Preparation of ivory for a ground for miniature painting, omitted in the firſt volume of this work, p. 281.

"TAKE the ivory leaves, or tables on "which the painting is to be made, "and, having cleanſed it, rub it over with "the juice of garlic."

This takes off that greaſineſs which is ſo much complained of, as preventing the colours from taking on the ground, and which is not otherwiſe to be remedied by the uſe of ſoap, or even gall. It is, however, effectually removed by this expedient, which was imparted to a gentleman by a lady eminent for her painting in this way in Italy, and by him to me, ſince the publication of the firſt volume of this work.

Method of weaving tapeſtry.

THERE are two manners in which tapeſtry is wove; the one is called the *high warp*, the other the *low warp*. The work produced is, nevertheleſs, much the ſame, and the difference betwixt the two kinds conſiſts principally in this, that, in the high warp, the loom is placed in a perpendicular poſition, and in the low warp, horizontally. The high warp was formerly moſtly practiſed, but at preſent it is much neglected, principally on the account of the greatly ſlower progreſs made in the work by this method than the other. The mark of difference, by which pieces may be diſtinguiſhed to be of either kind, is this, that in the low warp there is a red fillet of about an inch broad, running from top to bottom; which fillet is never found in the high.

The low warp being the moſt uſed, and conſequently the moſt important at preſent, I will firſt give the method of working in that way, and then ſubjoin the manner of working with the high warp, for the ſatisfaction of thoſe who may be deſirous, notwithſtanding the preſent neglect of it, to underſtand that alſo.

The apparatus, or ſet of utenſils for the low warp, are, the *loom*, the *flute*, and the *needle* or *comb*.

The

The loom is conſtructed much in the ſame manner as that of the weavers of cloth. The principal parts are two ſtrong pieces of wood forming the ſides of the loom, and bearing a beam or roller at each end. Theſe pieces are ſupported with other long ones at the bottom, in the manner of treadles; and, in order to fix them more firmly, and to keep them ſteady, they are faſtened to the floor as a kind of buttreſſes, to prevent their moving, which muſt otherwiſe be very incommodious, as there are ſometimes five or ſix workmen leaning on the beam at once. The rollers have each of them tronions, by which they are ſupported; and theſe tronions are turned by large iron levers or pins three feet long. In each beam is made a groove for the whole length, for containing the wich, which is formed of a piece of wood of two inches diameter, and almoſt of the length of the roller. This wich fills the groove intirely, and is fixed to it by ſeveral wooden pins placed at proper diſtances. The uſe of the wiches is for faſtening the piece of tapeſtry as it is wrought, ſo that it may be wound on one roller at firſt, and then be drawn off by the other, as the work advances. Acroſs the two ſides, almoſt in the middle of the loom, a wooden bar is placed, which ſupports little pieces of wood, reſembling the beam of a balance; and to theſe pieces are faſtened ſtrings, that bear ſpring ſtaves, by which the workman gives a motion to the coats, by ſetting his

feet on two treadles placed under the loom, and by this means makes the threads of the warp fall and riſe alternately.

The coats are ſhort pieces of ſtring, which are faſtened to the ſpring ſtaves, in order to fix the threads of the warp to it by means of ſliding knots; a greater or leſs number of theſe ſpring ſtaves, and a greater or leſs number of coats to each ſtave, are put on the loom, according to the nature of the piece of tapeſtry to be wrought, with reſpect to its conſiſting of a greater or leſs number of threads.

The flute is an implement correſponding to the ſhuttle in the ordinary looms. It is made of hard poliſhed wood, three or four lines thick at the end, ſomewhat round in the middle, and of three or four inches in length. The uſe of it is to carry the ſilk, worſted, or other matter employed as the woof of the tapeſtry, which is wound on it.

The needle or comb is made either of wood or ivory. It has generally teeth on both ſides, and is about an inch thick in the middle, but diminiſhing each way to the extremity of the teeth. The intention of it is to beat the threads of the woof cloſe to each other, when the weaver has paſſed and placed them with his flute among the threads of the warp.

The loom being put together, the weaver firſt lays the deſign under the loom in ſuch manner as may correſpond exactly with the work;

work; and then proceeds to fix the threads that form the warp, which is done by faſtening them at each end to the two wiches in the grooves of the roller.

The loom being thus ſet, all the coloured ſilk or worſted to be employed in the deſign (being wound each kind on their proper flutes, in order to their forming the woof) muſt be put in baſkets, and placed within reach; and the weaver then ſeats himſelf on a bench before the loom, with his breaſt leaning againſt the beam, on which a cuſhion is placed for that purpoſe. Being thus ſeated, he inſpects the deſign fixed under the warp, by moving away, or ſeparating the threads with his finger, which muſt be repeated from time to time, as often as there may be occaſion during the progreſs of the work. Then he takes the flute on which the colour firſt required is wound, and paſſes it among the threads of the warp, according to the deſign, after having raiſed them by putting his feet on the treadles, which move the proper ſpring ſtaves and coats. Having thus paſſed the flute acroſs, through the threads of the warp, to the extremity of the further ſide, he returns back in the ſame manner, where the work admits of it; and then he preſſes together, and cloſes the threads of this courſe with thoſe of the laſt, by means of the reed or comb with which he ſtrikes the threads, till they gain their due place. And this is to be done every courſe, whether it be double, by paſſing the woof

 from

from one ſide to the other, and then back, or to one ſide only. In the ſame manner the weaver muſt proceed till the whole be finiſhed, ſhifting the warp according to his convenience, by taking ſuch part as is wrought on the further roller, and winding off the ſame proportion from the neareſt to him, accommodating, at the ſame time, the deſign, by ſhifting the parts, through the means of the ſtrings by which it is hung under the warp.

There is a remarkable diſadvantage attends this manner of weaving, which is, that the weaver works as it were blindfold, the whole being done on the wrong ſide the tapeſtry, and not admitting of any view or inſpection till all the piece be finiſhed. It is, indeed, the ſame, with reſpect to the working, in the caſe of the high warp; but there the weaver may, whenever he pleaſes, by going round, ſee what he has done, and judge of the effect in every critical inſtance.

The apparatus for weaving tapeſtry in the high warp conſiſts of the *loom*, the *broach*, the *reed* or *comb*, and the *needle*.

The loom, which, as was before obſerved, is ſet perpendicularly, is formed of four principal pieces, viz. two long planks or cheeks, and two thick rollers or beams, all made of wood.

The planks are ſet upright, and are ſeven or eight feet high, fourteen or fifteen inches broad, and three or four thick. The beams are

are fixed acroſs the planks, the one at the top, the other at the bottom, at about a foot diſtance from the ground. Theſe beams or rollers have each of them tronions, by which they are ſuſpended on the plank, and they are turned round occaſionally by bars. In each of them is a groove from one end to the other, capable of containing a long round piece of wood faſtened in them with hooks; the uſe of which hooks are to furniſh a proper faſtening for the ends of the warp. The intention of the upper roller is to hold the warp which is wound round it, and the uſe of the under one to hold the tapeſtry as the work advances.

Within the planks are holes that are pierced in them from top to bottom, in which holes are put thick pieces of iron with hooks at one end, ſerving to ſupport the coat ſtaves. The pieces of iron have alſo holes pierced in them, by putting a pin in which the ſtave is drawn nearer or thrown further off, and the coats or threads, by that means, ſtretched or relaxed at pleaſure.

The coat ſtave is about three inches diameter, and runs all the length of the beam, and on this are fixed the coats or threads for making the threads of the warp croſs each other. The coat ſtaves correſpond in this kind of loom with the ſpring ſtaves and treadles, in the common looms, and that of the low-warp.

The coats are little ſtrings faſtened to each thread of the warp by a kind of ſliding knot, which forms a kind of maſh or ring. The uſe of them is to keep the threads of the warp ſeparate in a proper manner, to give a paſſage for the broaches on which the ſilk, worſted, or other matter is wound for forming the woof, and expreſſing the deſign of the piece.

The broach is made of hard wood, and is ſeven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This ſerves as a ſhuttle; the ſilks, worſted, &c. deſigned to be the matter of the woof, being wound round it.

The reed or comb is alſo made of wood, and is eight or nine inches long, and one inch thick on the back, from whence it grows thinner to the extremity of the teeth, which are more or leſs diſtant from each other, according to the greater or leſs degree of fineneſs of the intended work.

The needle reſembles the common ſewing needles, only it is both thicker and larger. The uſe of it is to ſettle and adjuſt the threads of the woof, where any appear out of their proper place, or not anſwer well their office.

The weaver has, beſides this apparatus, a number of little ſticks of different lengths, but all of them of about an inch diameter, which he keeps near him in baſkets; and theſe ſerve to make the threads of the warp croſs each other, by paſſing them through in the proper manner. But in order to fix them

thus

thus acroſs each other, a packthread is run among the threads above each ſtick.

The loom being thus formed and mounted with its warp, the weaver next applies himſelf to draw, on the threads of the warp, the outlines and principal touches of the deſign to be executed in the pieces of tapeſtry. This is done by fixing cartoons, made from the painting intended to be copied, to the ſide that is to be the reverſe of the tapeſtry, and then with a black lead pencil following the lines, and tracing out the contents of it on the thread of the right ſide, ſo that the ſtrokes appear equally both before and behind.

The original deſign or painting to be copied is alſo to be hung up behind the workman, and wound on a long ſtaff, from which the proper parts of it are unrolled from time to time as the work goes forward.

Every thing being thus prepared for the work, the weaver places himſelf on the wrong ſide of the warp of the piece, with his back towards the deſign or painting, to which he firſt turns, that he may ſee what is neceſſary to be done; then, taking a broach full of the ſilk or worſted, &c. of the proper colour, he places it amongſt the threads of the warp, which he brings croſs each other with his fingers, by means of the coats or threads fixed to the ſtaff, and being thus carried croſs the loom, he returns again, when the work admits of it, or otherwiſe does the ſame with ſome other colour. When he has paſſed the threads

threads one courſe, he beats them with the reed or comb till they come properly cloſe. If any change is to be made on the work, he turns again to the painting to take a freſh clue, and as ſoon as a proper quantity of the work is done, he goes round to the right ſide to ſee what effect the colours he has employed may have, and adjuſts and ſettles the threads, which are faulty or irregular, with his needle.

As the parts of the work are finiſhed, the piece is wound on to the lower roller, and as much of the warp unwrought is unwound from the upper; the ſame being done likewiſe correſpondently with the deſign or painting hung behind the weaver.

When the pieces are wide, ſeveral workmen may be employed at once; but the work proceeds, nevertheleſs, in the manner of weaving, much ſlower than in that of the low warp; even in the proportion of double, both with reſpect to the time and labour. There is nevertheleſs no material difference in the work when done; for all the diſtinction which is obſervable by the eye is, that, as was before obſerved, in the low warp there is a red fillet, about a twelfth of an inch broad, which runs on each ſide from the top to the bottom, and is never found in the work of the high warp.

Of the manufacture of paper hangings.

THE paper manufactured for hangings is of ſeveral kinds, ſome being made in repreſentation of ſtucco work, for the covering cielings, or the ſides of halls, ſtair-caſes, paſſages, &c. and others in imitation of velvet, damaſk, brocades, chintz, and other ſuch ſilks and ſtuffs as are employed for hanging rooms. The principal difference in the manufacture lies, however, in the grounds; ſome of which are laid in varniſh, and others in the common vehicles for water colours, and in the raiſing a kind of coloured emboſſment by chopt cloth.

This emboſſed ſort is called *flock-paper*; the art of making which is of very late invention, and is a great improvement of the manufacture of paper hangings, both with regard to the beauty and durableneſs.

Of the unwrought paper proper for hangings.

The kind of paper employed for making the paper hangings is a ſort of coarſe cartoon manufactured for this purpoſe, and there being a particular duty on paper hangings, it is required, under conſiderable penalties, to be ſtamped before it be painted, or otherwiſe decorated for this purpoſe. There is no occaſion however to be more particular in explaining the qualities of this kind of unwrought pa-

per, becaufe it is to be had of all the great dealers in paper manufactured in a proper manner.

Of the colours proper to be ufed for paper hangings.

The colours proper to be ufed for the painting or colouring the paper hangings, are all the kinds that can be ufed in water and varnifh; but, for common defigns done with water only, the following are moft proper.

For *red*, lake, vermilion, rofe pink, and red oker. For *blue*, Pruffian blue, verditer, and indigo. For *yellow*, the yellow-berry wafh, Dutch pink, and yellow oker. For *green*, verdigrife, or a mixture of the blue colours with the yellow colours, particularly with the yellow-berry wafh. For *orange*, vermilion, or red lead, with Dutch pink. For *purple*, a wafh made of logwood, or a mixture of the lake, or rofe pink, with deep-coloured Pruffian blue, or with indigo. For *black*, ivory black, and, in fome nicer cafes, lamp black. For *white*, whiting; and for the heightnings, white lead.

Where great brightnefs is required, the lake fhould be ufed for the crimfon red, and Pruffian blue for the blue; but, for many purpofes, rofe pink ufed alone for the crimfon red, and indigo mixt with whiting for the blue, will anfwer the purpofe with greatly lefs expence.

The

The lake, roſe pink, Pruſſian blue, and Dutch pink, intended for this uſe, ſhould be had, of thoſe who make them, in a moiſt ſtate, before they have become more dry than to be of the conſiſtence of paſte. There is a double advantage in this, that they ſave the trouble of levigation; and, mixing much more kindly with the vehicle than when they are dry, and to be ground afreſh, they both ſpread much farther on the work, and, lying more even, appear to be brighter.

The yellow-berry waſh employed for this uſe may be prepared by boiling a pound of the French berries with half an ounce of allum in a gallon of water, for an hour, in a pewter veſſel, and then filtering off the fluid from the dregs through a flannel or bag, or through paper for nicer uſes; returning afterwards the filtered tincture into the pewter boiler, and evaporating away part of the fluid till the remainder become of the ſtrength required, which may be tried by ſpreading it with a pencil on common paper. When this is uſed for grounds, no farther mixture is neceſſary. But when it is uſed for painting, this tincture or waſh ſhould be rendered thicker by the addition of half an ounce of gum Senegal or Arabic to a quart or more of the fluid, if found neceſſary. This waſh thus prepared is extremely uſeful and cheap, and is indeed almoſt the only yellow uſed for common purpoſes, either for grounds or paintings.

The

The logwood waſh may be made by boiling a pound of logwood in two gallons of water, till one half the fluid be waſhed away, and then ſtraining it through a flannel bag, while of a boiling heat, adding to it afterwards about a dram or tea-ſpoonful of pearl-aſhes, and evaporating ſo much of the remaining fluid as may render it of a proper ſtrength of colour.

Where this purple is deſired to be redder, half a pound of Brazil wood, or of Campeachy (called Peachy) wood, may be added, and the quantity of pearl-aſhes diminiſhed to one-fourth of a tea-ſpoonful. The gum Arabic muſt alſo be added, as to the yellow-berry waſh, where it is neceſſary. This is not, however, of ſo much importance as the yellow waſh; for the ſtain not being either very ſtrong or bright, it does not produce a very great effect, as it is laid on a white ground, and is itſelf tranſparent.

Where hangings of more delicate deſigns and greater value are to be painted, particularly thoſe in imitation of the India paper, carmine may be occaſionally uſed. But it muſt be laid on with the pencil, and employed ſparingly, otherwiſe it would too much enhance the expence.

The colours uſed in varniſh may be the ſame as thoſe uſed with water; but ſuch as are above directed to be had of the makers in a moiſt ſtate, muſt for this purpoſe be had dry. Verdigriſe, and, for nicer purpoſes, the chry-

ſtals

ſtals of verdigriſe, (commonly called diſtilled verdigriſe) are with advantage uſed in varniſh, though not proper to be commixt with water. A tincture of turmeric in ſpirit of wine gives a very good yellow, for uſing along with the other colours, in varniſh; but it muſt be uſed only on varniſhed grounds, as it will otherwiſe ſpread itſelf out of all bounds, and even run through the paper.

Of the vehicles for the colours uſed either for painting, or forming grounds, for paper hangings.

The vehicles for the colours, as before obſerved, are ſuch as are either formed of water or varniſh. When water is uſed, it muſt be inſpiſſated with ſize and gum Arabic, or Senegal. The proportion of the ſize muſt be adequate to the occaſion, for if the different parcels of the ſize differ greatly in ſtrength, no poſitive rule can be laid down. When the mixture is made for grounds, the water ſhould be made as ſtrong of the ſize as will admit its being commixt with the whiting, and, to ſave expence, the gum Arabic is ſparingly uſed, or almoſt wholly omitted in this caſe. But for the colours deſigned for painting, a larger proportion muſt be allowed; though, in this caſe, that of the ſize muſt be diminiſhed; for the mixture muſt not be too thick and glutinous, as it would prevent the ſharpneſs and clearneſs of the outline when

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the colours are laid on either with the print or ftencil.

In nicer cafes, where pencil work is required, the management of the colours, with refpect to the vehicles, muft be the fame as with the miniature painting; for which ample inftructions will be found in the firft volume of this work.

When varnifh is ufed, it muft be formed of oil of turpentine, and the refins and gums which will diffolve in that menftruum.

For common purpofes the following compofition may be employed.

"Take of white refin half a pound, of "fandarac and maftic, each four ounces, of "Venice turpentine two ounces. Powder them, "and then add two pounds of oil of turpen-"tine, and place the bottle in which the mix-"ture is put in a warm place, where it muft "remain till the refins, &c. be perfectly dif-"folved. The varnifh may be rendered thin-"ner, where neceffary, by increafing the pro-"portion of the oil of turpentine."

Of white and coloured grounds for paper hangings

The common grounds laid in water are made by mixing whiting with the fize prepared as above directed, and laying it on the paper with a proper brufh in the moft even manner. This is all that is required, where the ground is to be left white, and the paper being then hung on a proper frame, till it

it be dry, is fit to be painted. When coloured grounds are wanted, the same method must be pursued, and the ground of whiting first laid, except in paler colours, such as straw colours or pinks, where a second coating may sometimes be spared, by mixing some strong colour with the whiting. But where a greater force of colour is wanted, the pigment or colouring substance used must be tempered with the proper vehicle prepared as above directed, and then spread over the white coat.

Yellow grounds are best made by the yellow-berry wash, which being prepared as above directed, must be spread in the most even manner with a brush on the coat of whiting. If once going over do not produce a colour sufficiently deep, the operation must be repeated till the due effect be produced; the paper being hung till it be dry on the frame betwixt each colouring.

Purple grounds may be in the same manner made by the logwood wash, prepared as above directed, where a strong colour or great brightness are not required.

The varnish grounds are made much in the same manner, by mixing the proper colour with the varnish, and spreading it on the paper, which is the only method usually practiced. But a beautiful yellow, much brighter than any at present done, may be made by laying first a white coat of white lead and varnish, and then spreading it over with a tincture of turmeric, made in spirit of wine, which may either be

ufed fimply, or prepared, as when to be ufed as a laquer, according to the recipe in p. 505 of the firft volume of this work.

A much brighter pink ground than any at prefent made may likewife be obtained, by parallel means, from the ufing the Indian lake, improperly called fafflower, which diffolves in fpirit of wine, and will tinge the white coat laid in varnifh in the moft ftrong and beautiful manner.

Varnifh grounds are fometimes made where the paper is to be painted with colours without flock, particularly where green is defired, as that colour cannot be produced of equal brightnefs by water; but they are moft frequently where the figure is to be made by flocks. The reafon why it is not oftener practifed to make this kind of ground for the painted paper without flock, (confidering it is more beautiful in many cafes, and always more durable than the grounds laid in water) is the expence, which is much greater to the manufacturer than where grounds are laid on with water.

Of the manner of painting the paper hangings.

There are three methods by which paper hangings are painted; the firft by printing on the colours; the fecond by ufing the ftencil; and the third by laying them on with a pencil, as in other kinds of painting.

When the colours are laid on by printing, the impreffion is made by wooden prints, which are cut in fuch manner that the figure

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to be expreſſed is made to project from the ſurface, by cutting away all the other part. This, being charged with the colours tempered with their proper vehicle, by letting the print gently down on a block on which the colour is previouſly ſpread, conveys it from thence to the ground of the paper, on which it is made to fall more forcibly by means of its weight, and the effort of the arm of the perſon who uſes the print. The manner of doing this, when more particularly explained, is thus.

The paper, being properly prepared by a ground of whiting, colour, or varniſh, as above explained, is laid on a proper block, on which a piece of leather is ſtrained. The colour mixt with its proper vehicle is ſpread on another piece of leather, or oil cloth, laid on a flat block, ſomewhat larger than the print; which is done by a boy or man, who attends for that purpoſe, and having the colour by him in a pot, ſpreads it with a bruſh on the block betwixt every ſtroke and impreſſion the printer makes. The print is previouſly cut in ſuch manner, correſpondently to the deſign of the painting, that there ſhall be a projection on the ſurface anſwering to every part where that colour intended to be conveyed by this print is neceſſary. The printer then takes the print either in his right hand, or, when too heavy to be ſo managed, in both, and drops it gently on the block, juſt charged with colour; from whence he again immediately raiſes it in the moſt perpendicular direction, and lets

it fall in the ſtrongeſt, though moſt even manner, he can on the paper, increaſing the force by all the additional velocity he can give the print. When this is done, the ſheet printed is immediately taken off the block, and hung up to dry, and another being put in its place, the ſame operation is repeated till the whole quantity of paper be printed. It is eaſy to conclude, that there muſt be as many ſeparate prints as there are colours to be printed, and they are to be uſed ſucceſſively in the ſame manner as the firſt. But where there are more than one, great care muſt be taken, after the firſt, to let the print fall exactly in the ſame part of the paper as that which went before; otherwiſe the figure of the deſign would be brought into irregularity and confuſion. In common paper of low price it is uſual, therefore, to print only the outlines, and lay on the reſt of the colours by ſtencilling; which both ſaves the expence of cutting more prints, and can be practiced by common workmen, not requiring the great care and dexterity neceſſary to the uſing prints.

The manner of ſtencilling the colours is this. The figure, which all the parts of any particular colour make in the deſign to be printed, is to be cut out, in a piece of thin leather, or oil cloth. Theſe pieces of leather, or oil cloth, are called ſtencils, and being laid flat on the ſheets of paper to be printed, ſpread on a table or floor, are to be rubbed over with the colour properly tempered, by means of a large

large brush. The colour passing over the whole is consequently spread on those parts of the paper where the cloth or leather is cut away, and give the same effect as if laid on by a print. This is nevertheless only practicable without great care in parts where there are only detached masses, or spots of colours; for where there are small continued lines, or parts that run one into another, it is difficult to preserve the connection or continuity of the parts of the cloth, or to keep the smaller corners close down to the paper, and therefore, in such cases, prints are preferable. Stencilling is indeed a cheaper method of ridding coarse work than printing; but without such extraordinary attention and trouble as render it equally difficult with printing, it is far less beautiful and exact in the effect; for the outline of the spots of colour want that sharpness and regularity that are given by prints, besides the frequent extralineations or deviations from the just figure, which happen by the original misplacing of the stencils, or the shifting the place of them during the operation.

Pencilling is only used in the case of nicer work, such as the better imitations of the India paper. It is performed in the same manner as other paintings in water, or varnish; for which sufficient directions may be found in the first volume of this work, under those heads. It is sometimes used only to fill the outlines already formed by printing, where the price of the colour, or the exactness of

the manner in which it is required to be laid on, render the ſtencilling or printing it leſs proper; at other times it is uſed for forming or delineating ſome parts of the deſign, where a ſpirit of freedom and variety, not to be had in printed outlines, are deſired to be had in the work.

The manner of proceeding with theſe ſeveral methods is, in common work, to ſtencil firſt all parts of each colour in the deſign, and to give an outline to the whole at laſt, by printing with brown or black; but where there is any running part of the deſigns, ſuch as ſcrolls, or the ſtems or ſtalks of creeping plants, or flowers, which are to be printed in any other colour than brown or black, a print muſt be uſed for them; though, if they require only brown or black, they may be done by the ſame print which makes the outlines.

In the finer paper, where ſeveral colours are laid on with the prints, the principal colour is begun with, and the reſt taken ſucceſſively, the print for the outline being laid on laſt. In caſes where the pencil is to be uſed, the outline is nevertheleſs to be made before the colours are laid on by the pencil, if ſuch outline is to be made at all; becauſe that is the guide to the perſon who lays on the colour, and confines them to a correctneſs.

In paper printed with deſigns in *chiaro obſcuro*, ſuch as the imitation of ſtucco work, and baſs relieves, the order of printing muſt be to lay on the ground colour firſt, afterwards the ſhades,

ſhades, and laſtly the lights, and the ſame rule of ſucceſſion ſhould be obſerved where the colours are pencilled.

The colours for painted grounds in common work are principally laid on, as was before mentioned, with ſize, and a ſmall proportion of gum Arabic or Senegal, with which, being properly diſſolved in water, the colours of a dry nature are to be ground in hand or horſe-mills; but the moiſt colours may be commixt with the vehicle, by means of a ſtrong bruſh only, being put together in proper pots, and well ſtirred about. The dearer colours, ſuch as carmine, lake, or very bright Pruſſian blue, when uſed for paper of higher price, ſhould be treated according to the directions given for them, when uſed among other water colours, in p. 180 of the firſt volume of this work.

Of the management of the flock paper.

The paper deſigned for receiving the flock is generally firſt prepared with a varniſh ground, for as the flock itſelf requires to be laid on with varniſh, the other kind of ground would prevent it from taking on the paper, and render the coheſion ſo imperfect that the flock would peel off with the leaſt violence. The ground muſt therefore either be varniſh with ſome proper colour, or be that of the paper itſelf; but if, nevertheleſs, for cheapneſs, as was at firſt practiſed, the ground be deſired to be laid on with water, ſuch ground muſt be laid by the ſtencil, by which means the part where the

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varniſh is to be laid for receiving the flock, muſt be kept entirely free from the matter of which the ground is formed. Inſtead of the oil of turpentine varniſh, a compoſition of drying oil and reſin, to which ſome gum ſandarac may be added, might be uſed with advantage with reſpect to the expence; but the brownneſs of this mixture is injurious where the brightneſs of the colour of the flock is of any moment, and it is likewiſe ſomewhat more incommodious in the uſing, on account of its drying much ſlower.

It is frequently practiſed to print ſome Moſaic, or other ſmall running figure in colours, on the ground before the flock be laid on; and it may be done with any pigment of the colour deſired, tempered in varniſh, and laid on by a print cut correſpondently to that end.

The manner of laying on the flock is either by means of a print, or by a ſtencil; but as the ſtencil can execute nothing but detached parts, and conſequently is unfit for all deſigns where running work, ſcrolls, or other more complicated ornaments are introduced, it is extremely confined with reſpect to the nature of the deſigns for which it can be employed, and the print is therefore moſt generally preferred. The method of laying on the flock by means of a print is this: A wooden print being cut as is above deſcribed for laying on the colour, in ſuch manner that the part of the deſign, which is intended for the flock, may project beyond the reſt of the ſurface,

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the varniſh is put on a block covered with leather, or oil cloth, in the ſame way as was before directed for the colours, and the print is to be uſed alſo in the ſame manner, to lay the varniſh on all the parts where the flock is to be fixed. The ſheet, thus prepared by the varniſhed impreſſion, is now to be removed to another block or table, and to be ſtrewed over with flock, which is afterwards to be gently compreſſed by a board, or ſome other flat body, to make the varniſh take the better hold of it; then the ſheet is to be hung on a frame till the varniſh be perfectly dry, at which time the ſuperfluous part of the flock is to be bruſhed off by a ſoft camel's hair bruſh, and the proper flock will be found to adhere in a very ſtrong manner. When the ſtencil is uſed, the ſame method is to be purſued, the varniſh for holding the flock being laid on by that inſtead of a print, and the flock afterwards ſtrewed upon it, as in the other caſe.

The uſual method of preparing the flock is by cutting woollen rags, or pieces of cloth with the hand, by means of a large bill or chopping knife; but it is much more eaſily and better done by a machine, which may be worked by a horſe-mill, at the ſame time ſuch mill is employed for cutting diamonds, or any other ſimilar purpoſe. In ſuch caſe, the conſtruction of that part of the machine, which is made for the cutting the flock, is this.

A box is made for containing the rags or cloth to be cut, which is open at the

top,

top, and of ſuch ſize as may beſt ſuit the quantity of rags that the force employed can cut. A blade is alſo to be made, the length of which is to be equal to the breadth of the box, and it ſhould be ſtrong, and muſt be charged with as great a weight as the force employed can be made to raiſe with a quick motion. The box, being filled with the rags or cloth to be cut, is placed under the blade, and made to move by hitches, after the ſtroke of the blade is given, juſt ſo far as where it is proper the blade ſhould again cut the cloth or rags; while, at the ſame time, the blade is lifted up, and let fall on the cloth, which it cuts through, till by ſucceſſive ſtrokes, and the progreſſive motion of the box under it, the whole quantity of cloth or rags in the box has been cut. The box muſt then be turned, ſo that one of the ſides may become the front, and the operation muſt be repeated, by which means the cloth or rags, having been cut both ways, will be reduced to the ſtate in which the matter is called flock, and fit to be employed for the purpoſe of paper hangings. The work neceſſary for conveying from the principal mover in the mill, the motion for thruſting forwards the box, and raiſing the blade, may be eaſily ſupplied by any ingenious wheelwright, and need not therefore be particularly deſcribed here.

There is a kind of counterfeit flock paper, which, when well managed, has very much the ſame effect to the eye as the real, though done

done with leſs expence. The manner of making this ſort is by laying a ground of varniſh on the paper, and having afterwards printed the deſign of the flock in varniſh, in the ſame manner as for the true; inſtead of the flock, ſome pigment, or dry colour, of the ſame hue with the flock required by the deſign, but ſomewhat of a darker ſhade, being well powdered, is ſtrewed on the printed varniſh, and produces greatly the ſame appearance.

Of ornamenting the paper hangings with ſpangles.

It was formerly practiſed to give a glittering appearance to the coloured ground of paper hangings, reſembling the effect of a great number of ſmall ſpangles. But though this kind of decoration has been for ſome time almoſt intirely diſuſed, as to this manner of application of it, another uſe has nevertheleſs been made of it with good ſucceſs, which is, the laying on the glittering matter in ſuch figures as give greatly the appearance of ſilver embroidery, when the ground and colours of the paper are well adapted to that end.

The matter by which the appearance of ſpangle is made, is that kind of talc called iſinglaſs, which, being reduced to a groſs flaky powder, has a great reſemblance to thin ſilver ſcales or powder. When it is uſed for a ground, it is laid on by ſtrewing over the varniſh which forms the ground, before it be-

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gin to dry; but it muſt not be laid on in this caſe ſo copiouſly as the flock requires to be, but ſprinkled ſparingly, that the colour of the ground may ſhew itſelf betwixt the ſmall ſpangles. When it is laid on in a figure for the repreſentation of embroidery, the figure muſt be printed in varniſh, as for the flock, and the talc muſt be ſtrewed upon it, and treated in the ſame manner as flock; but in this caſe it may be uſed more copiouſly than in the other, and the whole of the ground of the figure covered. This ſort of paper is not much in vogue at preſent, but it might be very advantageouſly applied to ſome purpoſes; for the moſt elegant and rich deſign I ever ſaw in paper was executed in this way; the ground being yellow, with flowers of buff flock, and a ſmall running figure of the ſpangles mixt with them, which gave the paper ſo much the appearance of a cut velvet embroidered with ſilver, that the deception could ſcarcely be diſtinguiſhed at a ſmall diſtance even by day-light.

Smalt may alſo be laid on the paper in the ſame manner as the flock or ſpangles, and will have a very ſtrong effect, by the bright glittering colour it makes. It is too gawdy for common furniture, but might be applicable, very advantageouſly, to theatrical or other purpoſes, where great ſhow is frequently wanted.

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